ceres

FAO REVIEW Vol. 3 No. 3 May-June 1970

Behind the environment alarm

$1
8s
FF 5
L. 600

15

Fiat in specialized agriculture.

Mechanized pea harvesting in Hanover with a battery of Fiat 750 DT tractors.

FIAT Turin - Italy

CERES
VOL. 3, No. 3
May-June 1970
Published bimonthly by the Food and Agriculture Organization of the United Nations

Chief Editor
András Biró

Executive Editor
T.M. Pasca

Editor, English edition
Marcelle Biagini

Editor, French edition
Noël Givelet

Editor, Spanish edition
María-Teresa García

Art director
Dino Rigolo

Layout artist
Hans-Christian Besemer

Production and Circulation
Ramón Conde

Advertising
Edoardo Rossi Salazar

Editorial Advisory Board
J.P. Bhattacharjee
Claus W. Broicher
Theodore Kaghan
Antonio J. Posada
Mario Ruivo
Charles H. Weitz
Jack C. Westoby

Individual articles and photographs not copyrighted may be reprinted provided the credit line reads " Reprinted from Ceres, the FAO Review " and two voucher copies are sent to the editor. Signed articles which are reprinted must bear the author's name. Letters to the editor are welcome but must be signed (though the name may be withheld on request). Signed articles express the views of the authors and do not necessarily represent those of FAO or of the editors. The designations employed and the presentation of the material in Ceres do not imply the expression of any opinion whatsoever on the part of the authors or FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

CERES is available through subscription, bulk sales and a limited number of retail outlets.

Authorized prices are:

Subscription
One year (6 issues)
$5 - 40 s - FF 25 - L. 3.100
Two years (12 issues)
$9 - 72s - FF 45 - L. 5.600

Single copies
$1 - 8s - FF 5 - L. 600

Bulk sales
10 - 99 copies
$.80 - 6s 6d - FF 4 - L. 500
100 - 499 copies
$.70 - 5s 6d - FF 3.50 - L. 440
500 or more
$.60 - 4 s 6d - FF 3 - L. 380

Orders payable in any of the above currencies may be forwarded to:
CERES
Circulation and Advertising
FAO, Via delle Terme di Caracalla
00100 Rome, Italy

Orders payable in other local currencies may be forwarded to any of the FAO Sales Agents and Booksellers listed on page 66.
Advertising rates quoted on request.

In this issue...

Alexander Szalai

If ecology is one of the leading issues of the day, the subject of blazing newspaper headlines all over the world, there is good reason for it: the heavy toll industry has exacted from the world's resources to achieve its present preeminence in wealthy societies. The rapidly deteriorating balance between man and his environment is spreading alarm and anxiety everywhere.

In dedicating this issue of CERES to sober reflections and debate on the crisis, the editors did not intend merely to follow the fashion but rather to weigh the facts, to contribute toward a much-needed balance in evaluating the problem and to present an aspect of it thus far largely overlooked: the viewpoint of the preindustrial third world countries.

N.W. Moore

Environmental deterioration is as old as mankind, according to *Alexander Szalai.* There is nothing new in man's fundamental relation with nature except the present quantitative scale, brought to a critical pass by vast industrial expansion. We now realize that the capacity of nature to cope with waste and destruction is being rapidly exhausted; we must help it (page 22).

Ray Vicker

One of the most heatedly debated points in the current discussion concerns the use of persistent pesticides, especially DDT, the best known. Many rich nations have already banned it, but can the third world afford to do likewise? CERES offers two differing viewpoints: one, by *N.W. Moore,* analyses the effects of pesticides on complex environmental structures and deplores their contaminative action in the name of progress (page 26); the other, sustained by *Ray Vicker,* defends pesticides and reminds us that they have helped to save millions of lives in the past 20 years. He pleads for international research into long-term, safe innovations (page 30).

A.W.H. Needler

Babacar Diop

Two interviewees have their say on marine pollution, another cause for dismay. *A.W.H. Needler* informs us that new technical means of combatting this scourge are available, but unfortunately expensive (page 34). *Babacar Diop,* however, firmly maintains that the developing countries should not have to pay the costs of the rich nations' shortsightedness. It would be unjust, to say the least, if aid to the third world, already in decline, were further reduced by the high costs of a marine ' clean-up operation ' (page 38).

Worried by rampant pollution and wanton assaults on the earth's properties, man today is wondering whether our planet still possesses sufficient reserves. *Robert N. Colwell* describes a new method of research, made possible by modern technology: space photography. This device could give us an inventory of our remaining resources as well as invaluable information on how to use them rationally and to our best advantage (page 40).

Robert N. Colwell

Philip Stewart

Erosion is often believed to be an inevitable phenomenon. *Philip Stewart* explains how free grazing probably causes far more erosion than wind and water. The answer, he affirms, requires an effort by an integrated multidisciplinary team of specialists (page 47).

Wildlife is one of the third world's treasures, but in the past man's attitude toward it has been excessively romantic. Approaching the subject from a starkly practical angle, *Marcus Linear* points out that the profits wild animals can yield in proteins and currency are more important than the crocodile tears shed by sentimental souls (page 51).

André Philip

This issue of CERES coincides with the opening of the Second World Food Congress. *André Philip,* a delegate to the meeting, states the problems he believes must be thrashed out at The Hague to arrive at a viable global development strategy (page 19).

How can you increase rice yields?

. . . eliminate pests.

Apply Dimecron® The systemic insecticide against chewing, sucking and mining pests.

For use in all crops: rice, tobacco, cotton, sugar cane, olives, fruit, potatoes, vegetables, sugar beet and vines.

This insecticide is particularly suitable for aerial application.

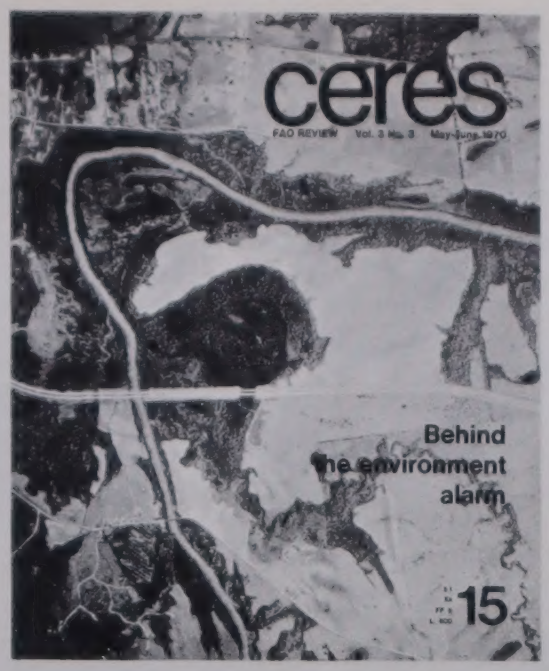
Choose

Dimecron

the established insecticide for bigger and better harvests

CIBA

Applied science for pest control
CIBA Limited, Basle, Switzerland



It appears to be
the only planet
that will support man.

World Report	7	
Opinion	13	
Commodities	16	
Medium-term planning at least	19	André Philip
Behind the alarm	22	Alexander Szalai
Implications of the pesticide age	26	N.W. Moore
The case of DDT	30	Ray Vicker
Pollution prevention is costly...	34	A.W.H. Needler
...but it shouldn't reduce the amount of aid	38	Babacar Diop
The earth's dwindling resources detected from space	40	Robert N. Colwell
Erosion, a social problem	47	Philip Stewart
The economics of wildlife	51	Marcus Linear
Books	57	
Forum	63	

The opinions expressed by the contributing authors are not necessarily those of FAO or of the editors of CERES. The mention of specific companies, products or services, or the claims made about them in advertisements published in CERES, do not imply that they are in any way endorsed by FAO.

World leader in tractor value

You can do a better job – right from the time you get your top value Selectamatic tractor. Anyone can operate David Brown's patented hydraulic control, saving work and time. For sugar and rice fields, rubber and tea plantations, the Selectamatic 36-72 horsepower range gives tough-guy performance. Experienced design, rugged diesel dependability, plus David Brown know-how equal top tractor value. Cut costs more with matched David Brown equipment. Get the facts from your DB distributor – he's technically qualified – and he'll save you money, too.

Power range 36-72 horsepower

Selectamatic hydraulic system, exclusive to David Brown, for finger-tip control of operations. A single lever selects the service for any operator.

To:

DAVID BROWN TRACTORS

(Sales) Limited,
Meltham, Huddersfield, England.

1966 1968
THE QUEEN'S AWARD TO INDUSTRY

A SUBSIDIARY OF THE DAVID BROWN CORPORATION LIMITED

Please send full technical details on the David Brown range

Name _____

Address _____

_____

_____

WORLD REPORT

AFRICA

■ *Codex Alimentarius*

In Africa the food products transformation industry is slowly but surely forging ahead and more national legislations in this field should be redrafted. The Commission of the Codex Alimentarius, executive body of the joint FAO/WHO programme to establish international food standards, is working to harmonize national food laws.

An FAO food legislation expert who visited five African nations in 1969 reports that food laws were either lacking or obsolete; that newly drafted legislation took little account of similar laws in neighbouring countries, and that, except for meat control, there was a dearth of personnel and training centres.

Since 1960, intra-regional trade in Africa has averaged approximately 7-8% of total African exports. This low percentage results because intra-African trade is carried out between member nations of different economic and monetary groups. The standardization of national food legislations would lower the barriers which separate the economies of the various countries.

The two basic kinds of national food legislation in Africa follow the French and British patterns. The laws generally regulate such fundamental matters as weights and measures and consumer health protection.

If new national laws conform to the rules now being drafted by the Codex Committee, it will be possible to harmonize not only legislations but also various systems of weights and measures.

African nations exporting to the developed nations are cautioned by the Committee to remember that the great majority of their clients maintain strict public health rules as well as qualified inspectors to enforce them.

INTERNATIONAL

■ *Technical advances in desalination*

Since 1966 more and better desalination plants have been constructed in arid countries. In the latest issue of *Aqua*, the quarterly bulletin of the International Water Supply Association published in London, M.J. Burley, of the Water Research Association of the United Kingdom, gives a detailed report on techniques and trends in the field.

He says that throughout the world there are now about 90 million gallons a day of desalination plant facilities in operation or under construction and demands for more are growing rapidly. Among these plants the most widely used techniques are multi-stage flash (MSF) for sea water and electrodialysis for brackish water but reverse osmosis and multiple effect distillation process equipment are coming into commercial use.

The report also says:

— Small advances have been made in the field of distillation, and development is still proceeding on scale-control, heat transfer and materials of construction.

— By redesigning the stack components capital cost savings of 30-40% have been realized in the field of electrodialysis.

— Many different reverse-osmosis systems are currently being studied, and small plants are now commercially available.

— The vacuum-freezing process has been demonstrated as entirely feasible, and small units are now available. Meanwhile development of the secondary refrigerant process is still proceeding.

— By operating desalination plant in conjunction with conventional water resources according to a planned rule, the effective cost of the increased yield can, in some cases, fall well below the costs of base-load desalination.

Costs of some of the processes can be reliably estimated and examples are provided in the report.

What will happen at The Hague?

Liberating humanity from famine and malnutrition and new possibilities for speeding up social and economic progress, especially in the field of agriculture, are the themes of the Second World Food Congress, starting 16 June in The Hague.

One aim of the Congress will be to mobilize men, resources and public opinion toward organizing and implementing action priorities. International cooperation for a more balanced global development will be stressed.

The Congress will function in two stages. Four commissions will analyse world needs and action priorities during the first stage, while in the second, four other commissions will weigh means to mobilize resources for action.

Commenting on the "leap forward" made possible by new high-yield grains, a basic paper prepared for the Congress declares that during this century, clearly "we do not face the slide into widespread famine feared by many agricultural planners and demographers over the past decade."

The document warns, however, that the battle to free all men from hunger is far from won; moreover, it says that short-term progress "could still be swept away in the long run if the world's population goes on growing."

Despite their initial success, the paper points out, the new high-yield plant varieties are far from perfect. Many are susceptible to plant disease and few are favoured by consumers. Therefore, greater efforts must be exerted to develop new varieties which are more resistant to disease, contain more protein and have greater appeal to the public.

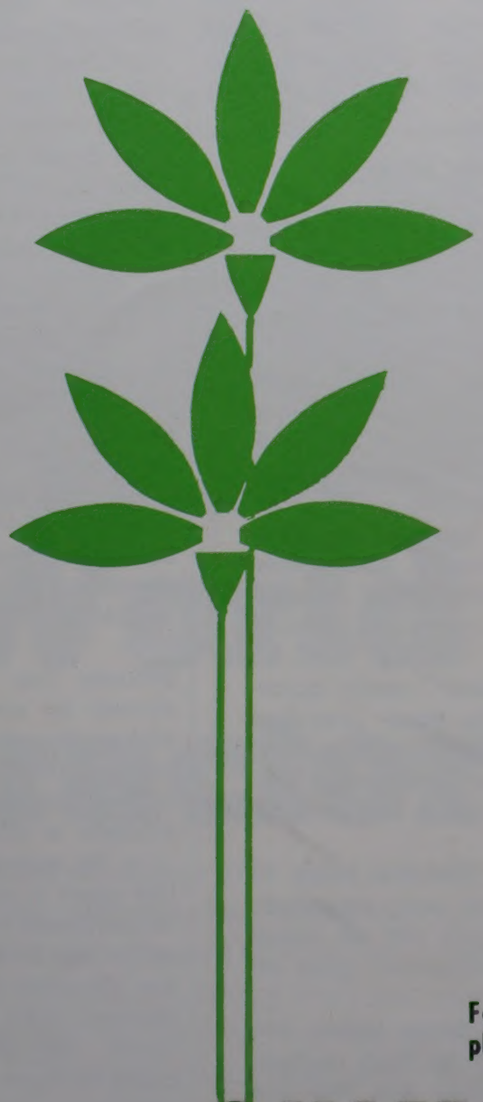
Where some countries have achieved spectacular success in increasing their cereal production through high-yield crop varieties, the report stresses that most developing countries lack the means to exploit such crops on a wide scale. In the majority of these countries, services and economic and social policies would have to be drastically overhauled in the field of agriculture. The report concludes that the changes, many of which will conflict with time-venerated customs, must be carried out by government-supported programmes.

MIDDLE EAST

■ *Financing for U.A.R. drainage project*

The United Arab Republic has received a $26 million loan from the International Development Association (IDA) of the World Bank to help fi-

FERTILIZERS



UREA

A concentrated artificial fertilizer
with high contents of nitrogen
Application: in agriculture and industry

AMMONIUM NITRATE

An artificial fertilizer for all types of soil
Application: in agriculture

AMMONIUM SULPHATE

Fertilizer with tested very good results
to almost any sort of crops

For detailed information and delivery terms
please contact:

CHIM IMPORT

Bulgaria

2, Stefan Karadja Street,
Sofia
Telephone: 88-38-11 (5 lines)
Telex: Sofia 522, 557

nance its giant $147 million Nile delta drainage scheme. This project, which will take about six and a half years to complete, is the world's biggest tile drainage scheme. It will drain and irrigate nearly a million acres of land and should thereby augment U.A.R. crop production by 20%.

This increased production is aimed at improving the country's balance of payments through additional cotton and rice exports and reduced wheat imports. The U.A.R.'s annual food imports are now $200 million a year. Higher incomes and living standards should accrue to 250 000 rural families.

Waterlogging has been a major factor in holding back production in the delta region. The drainage scheme involves laying of concrete or clay pipes horizontally below plant roots. This work was previously done by hand but in this case machines will be used in order to reduce costs, improve drainage efficiency and speed up the work.

The plan was developed by the joint Cooperative Programme of the FAO-IBRD. It will be executed by the Nile Delta Authority.

ASIA

■ *Fast growth of ADB lending*

Last year saw the rapid expansion of activities of the Asian Development Bank (ADB) and its commencement of " soft " lending.

According to its 1969 annual report, the regional bank approved 20 loans, including six on concessional terms, to ten developing member countries for a total sum of $98.10 million. This compares with seven loans totalling $41.60 million in 1968. Thirteen requests for technical assistance were approved last year against eleven in 1967.

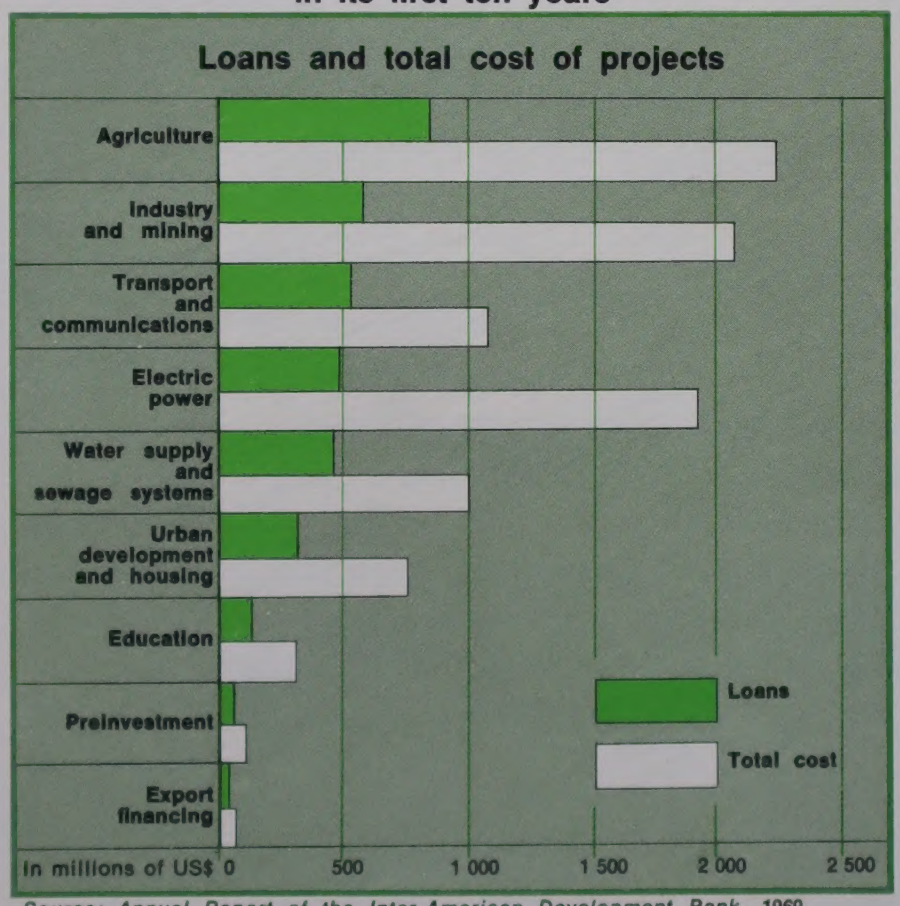
The ADB also floated its first Deutsche mark bond issue last year, for DM60 million, the equivalent of approximately $15 million.

■ *Financing for Ceylon irrigation and power*

The Mahaweli Ganga scheme for the development of agriculture and electric power in Ceylon will be launched with the assistance of $29 million in the form of a $14.5 million loan from the World Bank and a $14.5 million credit from the IDA.

The scheme contemplates the progressive development of irrigation for some 900 000 acres and the generation of about 900 megawatts of hydro-electric power, and may well become Ceylon's major development project during the coming decades. The World Bank and IDA funds will assist the first stage which involves improved water supply for 127 000 acres and a 40-MW power plant. The total cost of this stage is estimated at $50 million and the government is providing the remainder of the financing, $21 million.

How the Inter-American Bank used its money in its first ten years



Source: Annual Report of the Inter-American Development Bank, 1969.

The Inter-American Development Bank, at the end of its first decade (1959-1969), leads all foreign public financing organizations in its area for the period with a total disbursement of $3 429 637 186.

LATIN AMERICA

■ *Major Brazilian road expansion*

A $225 million Brazilian highway expansion has been adopted on recommendations made after a five-year study of the nation's overall transport facilities. A World Bank loan will cover $100 million of the cost.

About half the new roads will be constructed in northeast Brazil to integrate that sector, one of Brazil's poorest and most heavily populated, with the more developed regions to the south. Technical studies and economic factors call for traffic highways in the western regions which, although still sparsely populated, offer great possibilities for agricultural development, especially rice cultivation and stock breeding. The road improvement plan will lessen congestion on the much-used roads in the central and southern states. Lower vehicular operating costs and the reduced time required for transportation of goods will cut losses in perishable foods.

Highways are Brazil's chief means of transportation, with 72% of her freight and 92% of her travellers moving by road.

■ *Mexico increasing electric power*

Mexico is receiving $165 million in financing assistance from the World Bank and export financing institutions of ten nations for the expansion of electric power throughout the country this year and next.

The World Bank is lending $125 million while the other $40 million will come from banks in Belgium, Canada, France, the Federal Republic of Germany, Italy, Japan, Sweden, Switzerland, the United Kingdom and the United States, all supplier nations for the electrification project.

With this loan, Mexico becomes the World Bank's second biggest client (after India), having borrowed a total of $957 million. According to estimates, the programme will require a total investment of $491.5 million, of which the World Bank loan represents about one fourth.

In 1968, the public power sector had an installed capacity of 4 904 megawatts. The new project will add 2 984 megawatts, mainly in hydro-electric and steam plants; 5 497 miles of main transmission lines; and 10 200 MVA of main transformer stations. Plans call for expanding the distribution network and rural electrification. ■

The war on hunger could be won on land like this

In order to grow more food, large areas of land that were thought to be waste are being brought under cultivation.

The worldwide need to feed a rapidly expanding population is one of the most critical challenges facing nations today. Not only must more and more wasteland be put to use, but land already under cultivation must be made to yield bigger and better harvests.

FMC Corporation is helping countries find solutions to their food problems through the application of new knowledge and new methods. Our products and services apply to every stage of food production beginning with the preparation of the soil itself.

We provide the technology and equipment for complete water supply systems and for planting, growing and harvesting crops. Our agricultural chemicals protect crops from damaging pests. And we have the overall capability to design and build complete processing and packaging plants for all kinds of food products.

Because FMC can provide "single-source responsibility" in supplying all of these products and skills, we are making it easier for nations to achieve a higher level of food sufficiency. And to make our capabilities more readily available, FMC maintains production and sales centers throughout the United States and around the world. For more information, write FMC Corporation, San Jose, California 95106, or New York, N.Y. 10017, U.S.A.

FMC CORPORATION

Putting ideas to work around the world in Machinery • Chemicals • Fibers & Films

PRINCIPAL PRODUCTS: AVISCO fibers; packaging films; industrial strappings □ BOLENS compact tractors □ CHICAGO waste treatment systems □ CHIKSAN, O-C-T, WECO oil industry equipment □ FMC food processing equipment; packaging & converting machinery; systems engineering □ FMC industrial & specialty chemicals □ FMC defense materiel □ GUNDERSON railcars & marine vessels □ JOHN BEAN agricultural, automotive, airline, & fire fighting equipment □ LINK-BELT power transmission, materials handling, & construction equipment □ NIAGARA agricultural chemicals & seeds □ PEERLESS & COFFIN pumps □ SYNTRON & STEARNS electromagnetic equipment

All over our world

Climates change and soils vary. And so does fertility. It needn't. Restore soil's nutrient balance with RUSTICA straight nitrogen and compound fertilizers. Whatever and wherever soil, RUSTICA fertilizers solve your growing problems. That is RUSTICA's appeal. Fertilizers from RUHR-STICKSTOFF AG, Bochum, West Germany — one of the world's major nitrogen exporters.

3/666 e

RUSTICA® more than just a fertilizer

Watchdog needed

From "To Prevent A World Waste-nd," an article by George F. Kennan *ublished in* Foreign Affairs, *April 1970:*

There is a considerable body of opin-n, particularly in UN circles, to the ffect that it is a mistake to separate ie function of conservation and pro-ction of natural resources from that the development and exploitation of ese resources for productive purposes. ccording to this view, there should ot be separate organizations concerned ith conservation. Considerations of n environmental nature should rather e built from the outset into all those ctivities that are concerned with the roductive exploitation of natural re-ources, so that environmental needs vould be met, so to speak, at the source.

This writer must respectfully disagree. his is an area in which exploitative mo-ives cannot usefully be mingled with onservational ones. What is needed ere is a watchdog; and the conscience nd sense of duty of the watchdog must ot be confused by contrary duties and ndertakings. It may be boldly assert-d that of the two purposes in question, onservation should come first. The rinciple should be that one exploits vhat a careful regard for the needs of onservation leaves to be exploited, not hat one conserves what a liberal indul-ence of the impulse to development eaves to be conserved. . .

One is driven to the conclusion that anything very constructive is going to e accomplished along this line, the inter-st and initiative will have to proceed rom a relatively small group of gov-rnments; and logic suggests that these hould be those of the leading indus-rial and maritime nations. It is they vhose economies produce, in the main, ie problem of pollution. It is they, gain, who have the means to correct . It is they, finally, who have the cientific and other resources to analyse ie problem and to identify the most romising lines of solution. The devas-ation of the environment is primarily, hough not exclusively, a function of ad-vanced industrial and urban society. The correction of it is primarily a problem for the advanced nations.

One can conceive, then, by an act of the imagination, of a small group of advanced nations, consisting of roughly the ten leading industrial nations of the world, including communist and non-communist ones alike, together (mainly for reasons of their maritime interests) with the Scandinavians and perhaps with the Benelux countries as a bloc, constituting themselves something in the nature of a club for the preservation of natural environment, and resolving, then, in that capacity, to bring into being an entity — let us call it initially an International Environmental Agency — charged with the performance, at least on their behalf, of the functions outlined above. It would not, however, be advisable that this agency should be staffed at the operating level with governmental representatives or that it should take its decisions on the basis of intergovernmental compromise. Its operating personnel should rather have to consist primarily of people of scientific or technical competence, and the less these were bound by disciplinary relationships to individual governments, the better. One can imagine, therefore, that instead of staffing and controlling this agency themselves, the governments in question might well insert an intermediate layer of control by designating in each case a major scientific institution from within their jurisdiction — an Academy of Science or its equivalent — to act as a participating organization. These scientific bodies would then take over the responsibility for staffing the agency and supervising its operations.

It may be argued that under such an arrangement the participating institutions from communist countries would not be free agents, would enjoy no real independence, and would act only as stooges for their governments. As one who has had occasion both to see something of Russia, and to disagree in public on a number of occasions with Soviet policies, the writer of this article is perhaps in a particularly favourable position to express his conviction that the Soviet Academy of Sciences, if called upon by its Government to play a part in such an undertaking, would do so with an integrity and a seriousness of purpose worthy of its great scientific tradition, and would prove a rock of strength for the accomplishment of the objectives in question.

Not any growth

From Mrs. Inga Thorsson, *Director of the new UN Social Development Division, speaking to the UN Commission for Social Development in Geneva:*

It is my convinced opinion that the first step to be taken in order to carry out successfully far-reaching programmes aimed at a complete change of the trend of events so far must be the establishment of a generally agreed set of values that could guide the subsequent steps of decision making, priority setting, planning and implementation of plans, both at the national and the international level. It is, of course, precisely because of the prevailing controversies within nations and between nations as to value systems and priorities that the international community is ridden by such harmful tensions and disturbances that are witnessed daily. This reappraisal would include a serious questioning of the emphasis up to quite recently on measuring progressive development by figures for economic growth and growth rates. Quoting again from the UN World Economic Survey 1968:

"It is part of the present dissatisfaction with much postwar discussion of development . . . that it has not been distinguished from economic growth."

In the words of the report of the Stockholm Expert Meeting on Social Policy and Planning, the starting point must be the idea of "a single social system in which development occurs."

If society was looked upon as one single social system, then it would be possible to recognize that an infinite number of forces are at work within any given society, some of which are labelled political, others economic, social or cultural but actually all of them composed

Why should an engineering company be concerned about the health of babies?

Because nowadays engineering and health are closely interrelated.

For more than a century Stork-Amsterdam has been building food machinery as well as designing and erecting turnkey installations all over the world. They have developed the ultimate in food processing techniques.

You are invited to make use of the vast experience of the Stork specialists in the field of complete plant for the manufacture of:

Babyfood (dry, wet, based on milk, fruits, vegetables, meat, cereals) processed by methods and recipes obtained from leading Swiss babyfood manufacturers.

Dairy products of all kinds.

Protein rich foods, e.g. soymilk and its derivatives, based upon the extensive know-how of a specialized European firm in this field. Babyfood on soy base, enriched with amino acids, vitamins and minerals.

Cereal products, quick cooking varieties of rice, corn, oats, etc.

Please, let us know which field you are interested in and write for detailed information to:

STORK-AMSTERDAM

P.O. Box 108, Amstelveen-Holland. Tel.: (020) 452951, Telex: 11132.

all these elements. Some of these ces are conducive to development and y would have to be strengthened; ers are impeding development and y would have to be checked and con-lled, maybe even eliminated. In the urse and as a consequence of the velopment process, new forces would created, both positive and negative, side effects which would have to be edicted and, in case of negative side lects, if possible prevented, otherwise medied or alleviated.

That part of development which is lled economic growth and made pos-le through production would then, as matter of course, be measured on its sitive or negative contribution to the hole process. Not any growth would atter, but growth of what, for what nd whom and with what effects and onsequences. Because there seem to e — and this is increasingly understood — social costs involved in every tech-ological and economic step forward, a erious effort would have to be made to stablish the acceptable upper limit for uch undesirable social costs of econom- growth. That would enable policy akers and planners to make well-in-rmed choices and set constructive prior-ies.

More freedom for IBRA

From Correio de Manha, *Rio de Ja-eiro:*

Until recently, whenever there was a eed to increase production, there seem-d to be only one possible way — to rce the agricultural frontiers of the untry, expanding the cultivated area. his required only one limit or condi-on: that the land should be fertile nd the initial investments low.

Now, according to the president of RA (Istituto Brasileño de Reforma graria), this limit has already been ached. The question at hand is the troduction of profound changes in the oduction system and the agrarian ucture. In theory, IBRA has at its sposal the means to do it, by solving e problems of landless peasants and oadening the internal market. But e Institute is hamstrung and cannot act. It needs not only strength but also freedom of action to reach its objec tives. This is why, once again, we are insisting that the Agrarian Reform Insti-tute should recover the independence it enjoyed at the beginning, so that it may accomplish something, act.

In a cleft stick

From the Reith Lecture Series deliv-ered by Frank Fraser Darling *over the BBC and published in* The Listener:

Agriculturists, engineers, marketeers and so on use their technical skills to devise schemes that will provide food, power, employment and industrializa-tion for what are called under-developed countries. Perhaps it would only be a cynic who would say the real problem is too many overdeveloped ones. Brit-ain was early in this field and still pursues overseas development in a star-ry-eyed missionary spirit rather than a realistic one. I could list dozens of fiascos caused by blinkered thinking.

The disease of schistosomiasis has been endemic in Egypt, but its incidence has been moderate except in areas of perennial irrigation, such as the Delta. The disease is extremely debilitating and is caused by a tiny parasitic worm, the alternate host of which is a small water snail. Seasonal flooding doesn't favour the snail to the extent that perennial irrigation does. As a result of irrigation, the disease has now spread the length of Africa to an alarming extent, and in perennially irrigated areas the fibre of the people is being sapped. There is almost 100% infestation in the Delta, where sanitary measures are almost im-possible to implement because of the high water table and the seething popu-lation. In Upper Egypt the new Aswan High Dam development will certainly increase the intensity of infestation.

Furthermore, it might be mentioned that the impoundment of water in the Aswan High Dam is having a serious effect on the Eastern Mediterranean sar-dine fishery. Once more a source of protein is being given up for more starch.

The underdeveloped nations may be very rude to us of the West, but they have a perfervid belief in our technol-ogy. And were we to try to explain that we were not quite so sure of our cleverness, that we have made some deplorable mistakes, it would be inter-preted as one more example of the West wanting to deny the benefits of technol-ogy to the rest of the world. We in the West are in a cleft stick and some of us know it.

As the countries of Africa gained in-dependence, there was a voluble call from the Western world to save the wild life. Many well-known figures wrote eloquently to the effect that the wild life of Africa was a world possession.

Mr. Kenyatta picked this up imme-diately and in a very clever statement to the Arusha Conference of 1961 put the ball back in the white nations' court by pointing out that if African wild life was a world possession, it must be a world responsibility to pay for it. The West gulped once or twice, but on the whole the richer nations have stumped up rather well.

Settling the unemployed

From the National Herald, *Lucknow, India:*

Agrarian unrest, arising out of ex-ploitation by land grabbers, moneylend-ers and contractors dominating the ru-ral scene, at all levels, in Panchayat Raj bodies, is a manifestation of the feeling of helplessness among the unemployed. An extensive programme of absorbing the unemployed, therefore, becomes an urgent necessity and must be taken up in right earnest. Unless a conscious, nationwide, integrated programme is put into effect with the object of optimum utilization of surplus manpower, for a 10-year period, it is very likely that we shall repeat our failure of performance, as in earlier plans.

One of the most effective programmes for the absorption of educated and uneducated surplus manpower is through land colonization on a cooperative basis.

The settlement of educated and un-educated unemployed in a large network of cooperative farms will create a new order of young progressive farmers who can bring about radical and rational changes in farming techniques and rural life. ■

The outlook for pepper is uncertain

Pepper valued at about US$50 million is traded annually. While most of the countries of the world import pepper in some quantity, those which export it are relatively few and are all developing countries. The main exporting countries are Indonesia, India and Malaysia (Sarawak) which account for some 80% of world supplies. However, in Latin America, Brazil is a producer of growing importance, and in a matter of a few years has increased its share of the world market from some 5% to more than 10%. Exports from Africa originate mostly in Madagascar where, benefiting from substantial preferential tariff arrangements with the EEC until recently, production continued to increase rapidly during the sixties.

Aside from being characterized by a small number of developing suppliers, the pepper economy is marked by extremely large and frequent changes in prices. Prices fluctuate sharply as a result of short-term variations in crops owing to weather conditions; inevitably these movements are sometimes accentuated by speculative market operations. Between 1955 and 1968 the export unit values of total shipments from the main exporters fluctuated from one year to another at an average rate of about 25%.

Longer-term price movements, however, are the result of lagged adjustments in output to earlier price levels. In the early postwar years, world production was less than half that of the late thirties reflecting wartime destruction of plantations, poor maintenance and widespread disease of the vines. As a result of the shortage, prices rose dramatically to an average of about US$1.50 per pound during 1950-53, which in real terms was some 15 times greater than before the war. Thus stimulated, production expanded rapidly and in the mid-fifties had almost regained earlier levels. However, Indonesia's position as the largest producer and exporter by far had been eroded by the growth of output in India and particularly in Malaysia (Sarawak) where production increased almost 10 times and exports exceeded those of both India and Indonesia. As a result of the large expansion, prices began to decrease, falling to an average of about US$0.26 a pound in 1956/57. In countries particularly dependent upon export markets, such as Malaysia (Sarawak), production was sharply curtailed, while in other countries where a domestic market existed for part of the crop, the rate of expansion in production was greatly reduced. Prices recovered somewhat during the early sixties and averaged 41 cents a pound during 1961-66. Exports amounting to about 70 000 tons reached a peak total value of some US$56 million in 1966. While the volume expanded to more than 90 000 tons in 1967 and 1968, the value of shipments was actually lower: because of gradually increasing supplies from the traditional producers and expanding exports from a number of new regions, prices drifted lower until 1969.

As a result of these developments, the FAO Committee on Commodity Problems requested in 1968 that an analysis of the pepper economy be undertaken in collaboration with the governments concerned, to facilitate an appraisal of the longer-term outlook. At the conclusion of a fact-finding mission in early 1969, it was reported that the comparatively low prices then existing might check some expansion in production. However, in India a new factor had been introduced in achieving targets for increased output with the development of an improved variety of pepper plant, Panniyur I: it reportedly gave yields four times that of present varieties, and could result in considerably reduced costs of production. Moreover, Indonesian production was less affected by low prices since there were few alternatives to the crop in the pepper areas, while in Malaysia (Sarawak), although some reduction in the rate of new planting was expected, a basis existed for a further expansion in output in the next few years. Since world consumption requirements apparently increased only very gradually, a situation of oversupply could develop.

In mid-1969, prices began to increase following reports of a greatly reduced harvest of Lampong pepper in Indonesia and damage to the India crop by heavy rains in Kerala: quotations rose from about 39 cents a pound (Black Malabar, spot, New York) in July to about 50 cents in mid-September and reached a peak of 80 cents a week later. Since then prices have dropped back, but are still about 50% higher than before the increase. Trends in prices during the remainder of 1970 will be largely determined by expectations regarding the size of the new crops. It could be that next year's crop figures will restore stability to the market. In the meantime, however, higher prices may stimulate increased production.

Over the longer term, developments in consumption must also be considered. Pepper is produced in developing countries, and is consumed mostly in developed countries which, on average, take about three fifths of the quantities traded internationally. The United States is by far the largest consumer of pepper, and alone accounts for more than one fourth of net world imports. However, little growth has taken place in per caput levels in the early sixties — the postwar years. In fact, calculated levels were lower in 1961-63 than in the late thirties and have recovered only slightly since. Although imports in the prewar years were particularly large reflecting stockbuilding, it is interesting to note that these levels were not regained until 1967. Moreover, since per caput consumption is high — in fact, at more than 100 grammes, among the highest in the world excluding certain north African countries — scope for sizable increases is limited. Some scope for increased consumption may exist among Western European countries, where per caput levels vary from about 50 to 90 grammes per head. Imports into the EEC have been expanding for several years, and in March 1969 the Common External Tariff on unground black pepper was reduced from 17 to 10% while that on pepper used for the manufacture of essential oils was suspended, both measures extending until the end of June 1970.

In the centrally planned economy countries, consumption has been increasing rapidly, and these countries now account for about one fifth of net world imports. Apparent per caput levels are, with the exception of the U.S.S.R., now similar to those in Western European countries. In the U.S.S.R., these levels have increased steadily during the past 15 years, but at some 35 grammes are still relatively low. Comparison of the production and export

figures of producing countries suggests that, as before the war, some 30% of world output is consumed in these countries. However, such estimates must be treated with caution since production figures are often uncertain and no allowances have been made for changes in stocks for which little information is available.

How are these developments reflected in the pattern of international trade? First of all, despite the recovery in the postwar years, the volume of world exports did not reach the 1934-38 level until the early sixties. The increase in trade reflected mostly growing demand from new markets, particularly the U.S.S.R. and Eastern Europe rather than increased consumption in traditional markets. The recovery in exports from Indonesia, though still only half the prewar figure, is reflected in the larger shipments of that country to the United States and Western Europe. In the early sixties a large part of Indonesian exports — possibly close to half — was shipped to Singapore and then reexported to final markets. However, domestic processing of pepper in Indonesia has increased and a larger percentage of shipments is now made directly to final markets.

Indian exports have remained fairly stable in recent years. However, as a result of trade agreements, Indian consignments to the U.S.S.R. which accounted for one fourth of its exports in 1963-65, increased to over one half in 1968. Sarawak continues to market the bulk of its crop through Singapore, because of the flexible credit facilities and the processing and marketing services.

What measures could be taken to solve some of the problems of the pepper economy? Over the longer run, the market would need to be kept under review so that governments could, if necessary, harmonize production policies to keep supply in line with demand. There have been discussions concerning an international arrangement to secure a stable market with prices at a reasonable level for both consumer and producer and further intergovernmental talks are likely to take place in the near future. Of course, the effectiveness of an effort to reduce annual fluctuations in prices by an agreement on regulations of supplies to the world market would depend on the success of national control of exports and on arrangements for the holding of stocks, if necessary.

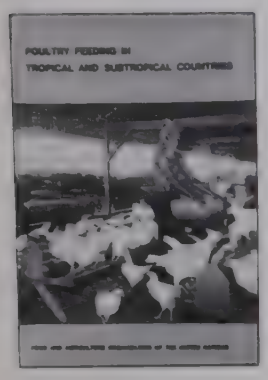
Because of the inadequacy of the information on the size of the current crops, prices are particularly sensitive to market reports. The FAO Committee on Commodity Problems, when it discussed the pepper situation at its November 1969 session, agreed that the FAO Secretariat should continue its studies on pepper and make special efforts to improve statistics, as well as work out proposals for stabilizing the market and increasing the trade in this commodity.

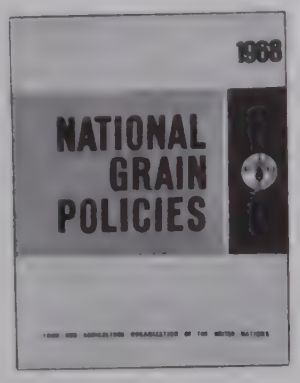
P. Fortucci

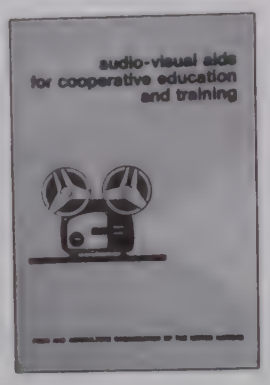
Countries	Average 1961-63	Average 1964-66	1967	1968	Change 1968 to 1969 (%)	1969 (prelim.)
Production [1]						*Thousand tons*
World total	96.3	118.9	130.9	126.0		—
Indonesia	42.3	46.5	49.0*	40.0*		—
India [2]	27.7	32.7	35.0	34.0*		—
Malaysia: Sarawak	8.4	15.1	15.7	20.8	+ 34	27.7
Ceylon	8.2	9.8	11.1	11.4		—
Cambodia	1.3	1.5	2.5	2.5*		—
Brazil	5.0	8.4	10.3	9.9		—
Madagascar	1.3	1.9	2.8	2.9		—
Other	2.1	3.0	4.5*	4.5*		—
Exports						*Thousand tons*
World total	57.3	65.6	92.7	90.6	+ 5	95.5
Indonesia	18.2	18.1	36.1	24.4	+ 11	27.0
India	20.5	21.3	20.9	24.8	— 24	17.5
Malaysia: Sarawak	11.5	14.5	19.8	23.2	+ 38	32.0
Brazil	2.7	5.9	9.7	9.7	+ 3	10.0
Madagascar	1.1	1.5	1.5	3.1	+ 6	3.3
Other	3.3	4.3	4.7	5.4	+ 6	5.7
Reexports						*Thousand tons*
World total	29.2	19.8	35.3	43.2	— 14	37.2
Developed	0.7	0.8	0.7*	0.7*		0.7
Developing	28.5	18.8	34.1	42.0	— 14	36.0
Centrally planned	—	0.2	0.5*	0.5*		0.5
Imports						*Thousand tons*
World total [3]	86.3	89.6	122.2	129.5	— 1	128.6
Germany (Fed. Rep. of)	4.3	4.7	6.0	6.0	+ 8	6.5
France	2.9	3.2	3.7	4.0	+ 8	4.3
United Kingdom	3.6	3.0	3.4	3.0	+ 20	3.6
Italy	2.1	2.5	2.6	2.6	+ 23	3.2
U.S.A.	18.0	20.1	25.5	24.1	+ 7	25.9
Canada	1.6	1.6	2.2	2.3	— 13	2.0
Singapore [3]	25.9	18.5	33.5	42.5	— 11	38.0
Argentina	0.9	1.1	1.3	1.0	+ 20	1.2
Africa	3.8	4.1	6.0	6.1	+ 7	6.5
U.S.S.R.	4.4	7.3	9.3	10.6	— 15	9.0
Eastern Europe	3.7	4.6	4.6	5.2	— 4	5.0
China (Mainland)	0.2	0.4	1.5	1.5*		1.5*
Other	14.9	18.5	19.1	20.6	+ 6	21.9
Value of exports						*Million US$*
World total	41.6	48.9	55.6	53.0	+ 12	59.1
Indonesia	11.8	11.7	18.2	13.4	+ 34	18 0
India	15.0	17.7	15.1	17.1	— 19	13.8
Malaysia: Sarawak	8.4	9.8	11.6	11.3	+ 38	15 6
Brazil	2.3	4.8	6.2	5.6	+ 7	6 0
Madagascar	1.3	1.2	1.0	2.0		2 0
Other	2.8	3.7	3.5	3.6*		3.6*
Prices						
New York: 3pot Black Malabar (US cents per lb)	39	43	38	38	+ 21	46
London: Sarawak White (sh. per 112 lb)	351	364	323	316	+ 27	402

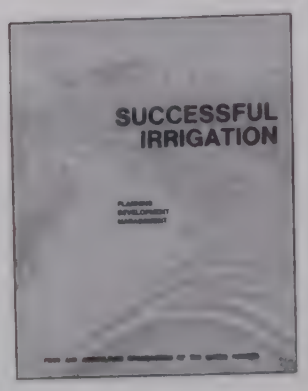
[1] *Season beginning in year shown.* - [2] *Unofficial estimate.* - [3] *Including estimates from 1964 of imports into Singapore from Indonesia.* * *Estimate.*

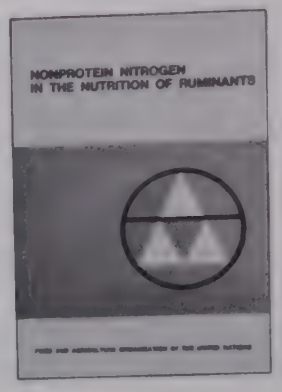
keep pace with progress in your field...

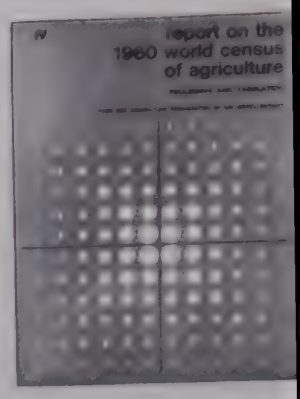












FAO is the leading world publisher of technical and scientific titles in the field of AGRICULTURE - ECONOMICS and STATISTICS - FISHERIES - FORESTRY and FOREST PRODUCTS - LEGISLATION - NUTRITION

These works are designed not only for specialists and educators but also for a wide general publi concerned with the latest developments in the continuing battle against hunger and malnutrition

The state of food and agriculture 1969
One of FAO's most important annuals, reviewing the agricultural situation in the world as a whole and by regions — including chapters on special topics of longer-term interest.
Available in English, French and Spanish editions, p. 196.
Price: $6.00 or 48s.

Rice milling in developing countries
FAO Commodity Bulletin Series No. 45
Analysis of the major characteristics and operational efficiency of rice-processing industries in selected countries — useful in formulating general principles to guide investment.
Available in English, French and Spanish editions, p. 33.
Price: $1.00 or 8s.

Impact of synthetics on jute and allied fibres
FAO Commodity Bulletin Series No. 46
Indicates trends in world exports, with emphasis on consumption and production, as well as on prices of synthetic products compared with those of jute and allied fibres.
Available in English, French and Spanish editions, p. 114.
Price: $2.50 or 20s.

Coconut oil processing
FAO Agricultural Development Paper No. 89
A manual which provides answers to many questions on methods of coconut oil processing and types of equipment. Also deals with layout of rural mills.
Available in English and French editions; Spanish edition in preparation.
Price: $3.00 or 24s.

Pests of the coconut palm
FAO Agricultural Studies No. 77
Intended for research workers, personnel of plant protection servi and growers, it presents an account of principal species of pe harmful to the coconut palm; also describes economic importan types of damage caused, and control measures applied to da References and index.
Available in English and French editions; Spanish edition preparation, p. 190.
Price: $3.50 or 2

Yearbook of fishery statistics Vol. 26. Catches and landings, 1968
Up-to-date statistics on quantity and value of fish catches a landings, by country, species and fishing areas.
Trilingual (English, French and Spanish), p. 312.
Price: $5.00 or 4

Yearbook of fishery statistics. Vol. 27. Fishery commodities, 1968
Fishery commodities covers disposition of catches and both producti and international trade data by types of fishery commodities.
Trilingual (English, French and Spanish), p. 330.
Price: $5.50 or 4

Trade yearbook 1968
This authoritative reference work contains statistical information international trade in major world agricultural products.
Trilingual (English, French and Spanish), p. 580.
Price: $7.00 or 5

INFORMATION AND CATALOGUES ARE AVAILABLE ON REQUEST
from Sales Agents and Booksellers (see list on page 66)
or from the Distribution and Sales Section, FAO,
Via delle Terme di Caracalla, 00100 Rome, Italy

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATION

André Philip: medium-term planning, at least

I am certain that the Hague Congress will prove to be a significant event for it coincides with certain changes and technical innovations in the realm of agriculture. Some of the overall problems to be reviewed go far beyond the competence of FAO. Although the conference will not be able to solve them, I believe that it must bring them up to spur the various international organizations to carry out essential research.

To create work

In my view there are three basic problems. The first concerns the distribution of income and employment. Much has been said about the new green revolution, which has inspired great hopes, but its results will vary greatly, according to how the new technology is applied. If governments grant their small peasants the credits they need to buy seeds and fertilizers and to dig wells, then an increase in agricultural employment will follow, since two or three crops a year mean more work, hence a demand for more workers. Moreover, as the peasants' diet improves, they will not be content with only wheat and rice; they will want other kinds of foods, and convert some of the land from grain farming to arborescent and market-gardening cultivations, which will require additional hands. In this respect, our hopes are high.

The technological revolution in agriculture during the past three years has thus shown that the world is not plunging inexorably toward famine. By simply exploiting new varieties of wheat, rice and fertilizers, nations could rapidly pass from a stage of underproduction to one of surplus production. This has occurred in West Pakistan, for example, which imported more than a million tons of grain in 1967-68; with the current 1969-70 season, the country has become a net exporter, and a probable export volume of over two million tons is indicated for 1974-75. Hence, we have the technological means to avert the oncoming, much-discussed famine, but only on condition that fertilizers — to mention only this one production factor — are available. The need for aid to import products and raw materials is enormous, and experience shows that the potential returns of such aid are, in certain cases, higher than investment aid, at least in the case of agriculture. In India and Pakistan, all fertilizers are now being imported through international aid financing.[1] Should this aid decrease or fail to keep pace with expanding needs, the spectre of famine could well reappear. We must stress the fact that, in the light of recent developments, the solution to the problem of world hunger hinges largely on the amount of aid allocated for the importation of such products as fertilizers, pesticides, pumps, and so on.

On the other hand, if the essential resources are not forthcoming and if only the middle peasants, who already have the funds they need, adopt the new technology, then the others, poor peasants, will be ruined by the trend to lower prices resulting from increased production. They will then leave the land for the cities, only to face unemployment, and the low purchasing power in the cities will not permit the normal sale of agricultural surpluses. An inadequate distribution of these surpluses will, in turn, impede any progress in agriculture's new technical revolution.

I believe that we must face up to this problem and realize that the conditions essential to a successful food policy depend on a fair division of resources and a general policy based on employment, which aims to create buying power for surplus agricultural products. Toward this end the Development Centre of the OECD is currently engaged in 18 research projects on problems involving employment, the introduction of simplified techniques on a

---

André Philip, *who heads the Development Centre of the Organization for Economic Cooperation and Development* (OECD) *in Paris, has been named chairman of the commission dealing with public sector support at the Second World Food Congress in The Hague. He has served France as Minister of Finance, President of the Constitutional Commission of the Constituent Assembly and Chief Delegate to the European Economic Commission.*

broad scale and the establishment of small and average industries in market towns. (This is a problem which I believe must be considered.)

In close connexion, we must also study every aspect of the peasant's training: his elementary, secondary and advanced schooling and all forms of extension educational programmes. Peasants should be trained to manage their own destiny, to create something on a cooperative basis and to confront all the difficulties involved.

Only a month or two ago I had an extremely interesting experience. With several experts I spent eight days in Tanzania to discuss the country's second plan with the officials in charge, and particularly, the policy of general rural planning. Tanzania's experiment in establishing cooperative villages — of which there are now 400 — seemed especially interesting to me. I am not sure that they will be successful, indeed I believe that they will fail to the extent that they will succeed because the villages will not all develop at a uniform rhythm and, consequently, policy choices will have to be made. Should all the villages be maintained on a coordinated scale or should the more successful of them be pushed and the others dropped? Should the same criteria be applied on the regional and district level? There will be a whole range of problems which we discussed with government officials. But Tanzania is experimenting with a transformation of structures and thinking which I find exciting, whatever the final outcome may be. In other words, in the wake of technological progress, the main problem is to watch carefully the sharing of the resulting benefits and the transformation of structures in the developing countries.

Changing the structures of industrialized countries

The second problem concerns the transformation of structures in industrialized countries. The experiences of the last ten years can now be clearly evaluated. At first, there was an attempt, through marketing organizations, to raise the price of agricultural and mineral commodities sold today by the underdeveloped countries. There have been results, but, as we well know, they are minimal; we are up against a lack of elasticity in the demand and the completion of synthetic products.

Let us take a closer look at the substitution of synthetic products for natural products, taking jute as an example. This substitution is not inevitable. If prices were kept low and stable enough, jute could compete with synthetics instead of being inexorably replaced by them. Indeed, the price of jute could have been held down in India, and certainly in East Pakistan, had agricultural research (into new varieties and fertilizer utilization) progressed more rapidly and had the new techniques been diffused more efficiently; this would have avoided, for example, the stagnation of Pakistan's export revenues. In this respect, agricultural research is an essential factor. We must not forget that the green revolution stemmed simply from the exploitation of two new varieties of wheat and rice — and at a low total cost in research. We must persist along this way. There are other achievements to attain, but we know that there are limits which cannot be exceeded.

Likewise, there is a problem of aid, but this must not be pressed at The Hague. It has already been widely discussed and there is no question of resuming the debate on the Pearson Report. Yet, we can emphasize several basic questions. For example, certain problems should be clarified if we understand that only outright gifts or loans advanced at very low interest rates can be considered public aid. And what we call private aid is not aid, but investment. Investments are useful but they are something else again, and we must not confuse the two things. Where aid is concerned, we can improve the propagation of information and perfect technology and bilateral aid can be made multilateral. There is a whole new technique to be adopted. There is progress. But here again we confront a barrier: the industrialized nations' reluctance to increase the volume of aid. However, one measure could be applied with profit, at least for certain categories of products: to remove the strings attached to aid granted the developing countries. Thus India, for example, would be allowed to use aid in dollars to buy imported fertilizers at the lowest prices on the international market from producers invited to submit tenders.[2] The donor nations' balance of payments problem would be solved if a third partner entered the scene, and pledged to spend these dollars on imports from the United States. The untying process would liberate and strengthen exchanges and improve economic integration among the developing countries.

Henceforth, I believe, the basic question will revolve on the rise of new exports as the developing countries become competitive in the agricultural and industrial spheres. There are immense possibilities, but again the resistance and protectionism of the industrialized nations constitute a barrier. The problem would

not be solved by lowering customs duties, by eliminating quota restrictions or even by preferences; rather, what is needed is a new series of international agreements by which the developed countries would pledge to allow imports from the developing countries to fill a certain percentage of their growing national consumption, for a determined period, on a product-by-product basis.

But this would entail a transformation of their structures. The public would be obliged to pass up Languedoc wines for Algerian wines. Beet sugar production would have to be curtailed to increase the purchase of cane sugar. Europe's dairy policy would have to be modified to allow for imports of African fats. But peasants and labourers of industrialized countries would encounter serious difficulties in adapting to such changes. If we want to expand purchases from labour-intensive industries such as textiles, clothing and shoes, this would create problems so difficult that they could only be solved within the framework of a long-term agricultural and industrial policy over a period of perhaps 15 years, planned in stages and providing for financial compensations to protect those adversely affected by the changes against the painful injustices which would inevitably follow. In other words, an aid policy for the developing countries cannot be confined within the framework of a liberal policy; we — the industrialized countries — must have a planning policy or at least a policy of middle-term programming which embraces all these problems.

The history of the European Community shows that, in the long run, there is no conflict of interests between the developing and the industrialized countries. The measures required to answer the needs of the developing countries are the same as those we must take in any case to adapt ourselves to the new industrial revolution. But in the intermediary period — the coming 15 years — adjustments will be difficult and painful.

Toward an international development law

Finally, we must envisage new structures in international trade. We can no longer think in terms of small enterprises competing in a free market and adapting to the fluctuations of supply and demand when vast supranational combines are looming larger and larger. These combines will dominate the world in 20 years. We know it. They will alter every aspect of the problem. They contribute something, they represent a considerable technical advance; to have a global price and production strategy can be an asset but only providing that it is balanced by compensating powers constituted both by the industrialized and developing countries, joining together to evolve a strategy for negotiating with the private corporations. To counter them, public supranational enterprises must be established on a mixed economy, with both private and public capital invested within the framework of a global agreement.

In the matter of private investments, we should take note of what certain developing countries, such as Algeria and Tanzania, are doing. They balk at private ownership investments but they will willingly grant a 10- or 15-year management contract to a private firm to provide know-how in exchange for a share of the output. There are all sorts of viable combinations that can be worked out, separating management participation and technical cooperation from ownership.

All this remains to be invented. A new structure of international trade is needed, one which discarding the 19th century free market system will be based upon the emerging of a new international development law.

All these problems must be raised at The Hague, even if they cannot be solved on the spot; indeed, they require 10 to 15 years of study. At the OECD Development Centre we have launched a series of studies on these problems and expect to publish our first conclusions in a year or two.

But this constructive action requires, on the part of the ILO, the World Bank, FAO and other international organizations, a far more energetic cooperation than they have shown in the past toward shaping up a world development strategy. We shall not be able to solve everything at The Hague but, with an analysis of agricultural problems as a point of departure, I believe that we must state the problems I have indicated here. If we do not want the young generation to pose them in a negative, mystical and pseudo-revolutionary mode, then we ourselves must face them frankly, clearly and in technical, scientific and organizational terms. ■

---

[1] *Studies made by the Development Centre of the* OECD *on these two countries show that after priority imports have been completed, there is practically no currency left for such vital imports as fertilizers.*

[2] *India could import nitrate fertilizers from the Persian Gulf area at prices notably lower than those she pays for American fertilizers.*

Behind the alarm

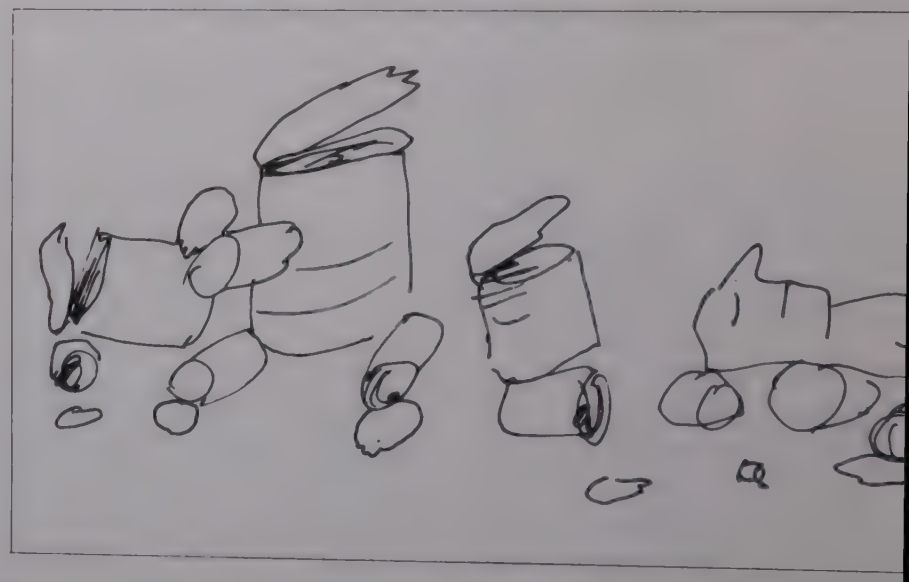
Most people who read at all, whether only popular newspapers, magazines, paperbacks, or also learned journals and books of a scholarly kind, must have been impressed and indeed overwhelmed by the torrent of highly dramatized statements and announcements currently sweeping over the printed pages about the environmental doomsday.

The most amazing thing about this worldwide phenomenon is that responsible and farsighted medical people, biologists, zoologists, botanists, researchers on urban development, climatologists, oceanographers and so forth have been reporting for decades on damages done to the human environment and have warned of the growing dangers to human well-being and welfare. Practically nobody listened, nobody cared. Now, suddenly, all this is in the headlines and all over the world people have become shocked and terrified. Why all of a sudden? What is so new about all this? What has happened just now to provoke such an abrupt outbreak of panicky popular concern in so many countries around the globe?

One of the factors that may have played a role in this sudden awakening of a global concern about the human environment was probably the experience of mankind with the huge series of atmospheric atomic bomb tests which have fortunately now been banned. Those man-produced mushroom clouds with their dangerous fallout carried around the earth by winds and sea currents and seeping into plants, cattle, and even into mother's milk made mankind at once aware of the terrifying power our technology has acquired over the whole realm of terrestrial life and of the fact that we have just one globe to live or to die on.

This consciousness and this concern must have been reinforced and sharpened to a considerable extent when a few years later mankind had an opportunity to look at the globe in its totality from the 'outside' — when television screens everywhere conveyed to the eyes of many hundred million astounded viewers the sight of Mother Earth the Beautiful, of that self-contained and lonely sphere drifting in space, covered by interwoven arabesques of blue oceans, green and brown continents, and white clouds — with no sign of human life visible at that distance but apparently the only place within myriads of miles in space where conditions for human life prevail. The cold and emptiness of the cosmic avenues through which the rockets of the astronauts sped and the deadly grey aridity of the moonscape when they first set foot on the moon rounded out the picture in a very impressive way.

But the psychological impact of these recent experiences conveyed to and indeed impressed on mankind through the all-pervading channels of contemporary mass media would have hardly sufficed in itself to produce this sudden awakening of environment-consciousness and environmental concern had not a much more basic material process acquired such awesome dimensions that nobody could overlook it any more. This process happened to be the exponential growth of industrial production — and of waste and garbage on the very same scale.



"... an increase by nearly $300 thousand million in the yearly output

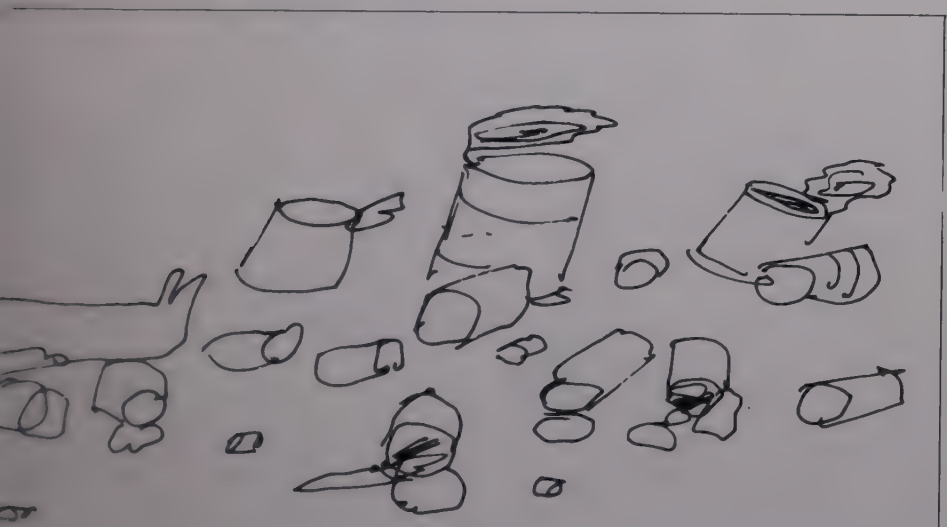
If anybody has money to put in a bank where a yearly interest of 5% is paid, i.e. where the money increases at the rate of 5% per year, he will find that in about 13 years his money will have doubled. Simply by the law of compound interest, anything that grows at the rate of 5% a year will produce, within not much more than a decade, an additional volume equal to the original amount that existed at the beginning of the period. Now, industrial production has been growing for quite a while in very many industrialized countries of the world at a rate of about 5% per year, and nowadays this is not even regarded as a particularly high gross rate. As an American economist put it recently, this means, for instance in the case of the United States, that the amount of goods and services has grown by as much since 1950 as it grew in the entire period from the landing of the Pilgrim Fathers in 1620 up to 1950. In 1957 — only 13 years ago — the gross national product of the United States was $454 thousand million. In 1969, in constant dollars, it

Professor Alexander Szalai *is a Hungarian sociologist who is at present Deputy Director of Research at the United Nations Institute for Training and Research* (UNITAR) *in New York.*

We are experiencing nature's inability to absorb industrial man's massive wastage

by ALEXANDER SZALAI

was $728 thousand million. That is an increase by nearly $300 thousand million in the yearly output of tin cans, electric power, automobiles, paper, chemicals, and all the rest, accompanied by a proportionate increase in the output of tin cans thrown away after use, of vapours, fumes, soot blown out from smokestacks and automobile exhausts, and of all sorts of garbage and refuse piled up or poured into lakes and rivers. In a sense it is not the awakening to the dangers of pollution and environmental deterioration which came all of a sudden — it is pollution and environmental deterioration of such eye-, nose- and lung-hitting dimensions that was nonexistent a relatively short time ago and that was dumped



..., electric power, automobiles, paper, chemicals, and all the rest . . ."

on us as a kind of malignantly compounded interest of contemporary industrial growth and development.

There is, however, a very manifest danger of emotional over-reaction to this serious situation — a sort of Luddite machine-smashing, putting the blame on scientific and technological development as such and propagating some kind of ' return to nature ' as an avenue of escape, just as if nature were in its alleged ' purity ' the best friend of man. Granted that mankind needs to preserve in some well-chosen places particularly beautiful and edifying natural landscapes in their untouched natural state and green squares and parks as breathing spaces in his cities, granted too that he should not prey on any of the remaining species of living creatures to an extent that would lead to their complete extinction, and that he should be extremely careful not to exploit those natural resources that can be replaced at a rate that makes replacement impossible; and furthermore that he should think at all times of maintaining a balance in his environment, making it a livable place, and a place worth living in — granted all that, reverence for ' virgin nature ' and extreme conservationism are not attitudes that can show us the way out of the present dilemma.

What is dirt, filth, garbage? Well, it is simply any kind of stuff, any kind of material in a place where it should not be. The notion of a ' pollutant ' encompasses any kind of misplaced matter or even energy (heat, noise, radiation) which is thus disturbing to man because of its whereabouts. The essential point to observe is that the criteria for what constitutes dirt, filth, garbage or pollution are determined by man's environmental needs, by the conditions for human health and welfare, by demands of human beings and nothing else. To take an extreme example, faecal matter is, of course, not dirty or filthy as long as it is contained in the intestines where it should be as the end product of the normal process of digestion, neither does it constitute dirt or filth in the sewage system which serves to collect and convey such matter to the right place, nor if it happens to be spread as dung and manure over the fields where it is needed for agricultural production. However, if dropped or seeping into any unwanted place it constitutes a particularly offensive and unhealthy type of refuse.

Except in a poetic or romantic sense, it is fairly meaningless to speak of any ' purity ' in nature. Nature as such is neither pure nor dirty. Rotting and putrefaction are as much part of nature's processes as the production of sweet fragrances and one does not go without the other. Nor are unaltered products of nature necessarily the best for human beings. Driving back nature has from the very beginning been a precondition for human survival and development. Thus, man is the measure for everything, including pollution. Oil bubbling up from the ocean floor, an entirely natural process which occurs in a number of places without any intervention of human industry, can pose problems quite similar to those which pollution of the sea by oil spillage or the flushing out of oil tankers on the high seas produce.

What man needs for his development, for his survival at the present stage of his proliferation over the globe and of the complexity of techniques needed to sustain him is a certain equilibrium between man-made systems and natural systems; between the exploitation of his resources and their replenishment by nature or by human effort in opening up new sources of energy and matter; between the transformation of his natural habitat and the preservation of those elements in it which are needed for his well-being. The point of equilibrium is subject to shift with development. Originally several square miles of relatively fertile natural sur-

roundings were needed to sustain a small human family wandering around to gather whatever 'consumables' it could find. Nowadays the man-made system of agriculture permits the production of food for thousands on a square mile of land, though some endowments of the natural environment had to be transformed, others reinforced, and still others eliminated for this purpose.

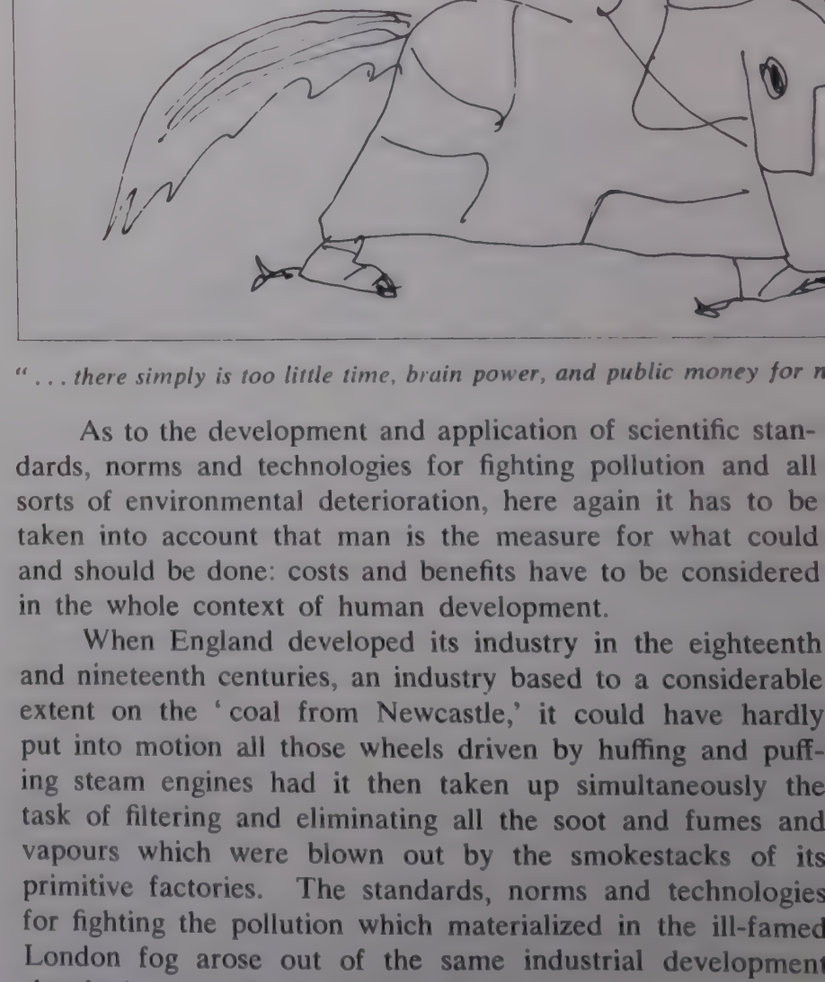
It's man's own task

The real problem arises where the consequences of the transformation of nature, of the interaction of man-made and natural systems have not been foreseen or have not been provided for — where we suddenly find that man's exploitation of natural resources has wrought damages in the environment which neither nature's own forces can repair nor human efforts can overcome except perhaps at a prohibitive price and at the cost of other efforts destined to enhance human welfare and well-being.

Nature itself has a wonderful capability to take care of environmental disequilibrium, even of waste and refuse produced by human industry — up to a point. Winds, bacteria, physico-chemical forces such as corrosion, rusting and other forms of oxidation break up and 'recycle' into natural processes much of the fallout of industrial civilization. However, natural forces in the service of environmental restoration are not omnipotent — neither quantitatively nor qualitatively. Great rivers can absorb a very considerable amount of pollutants and 'clean' themselves, that is to say restore the original quality of their water, while running their course. By crumbling up, diluting, dissolving and depositing various ingredients of pollution they make them accessible to decomposing forces of oxidation and fermentation, to ingestion and assimilation by micro-organisms, plants, animals, and even man himself. However, there are limits to what even the greatest river can do with waste and refuse, how much and what kind of waste and refuse it can 'break-down.' Most organic offal of natural origin whether from plants, animals or human beings understandably fits well into the metabolism of nature and is decomposed relatively easily; at the other end of the scale we find such wastes of industrial civilization as discarded aluminium cans, ceramic and plastic containers, and certain refuse from the metallurgical and chemical industry which could pile up for ever. In between we have an enormous amount of various other types of garbage which can be decomposed and 'recycled' by nature only at a much slower pace than civilization piles them up.

Thus, man can count on nature only to a moderate extent to repair damages which he himself has brought about in his environment. Or rather, the restorative forces of nature have to be handled by man as most valuable natural resources of a limited kind which he can use only very thriftily. For the rest, he must regard the maintenance of his environment as his own task — very much like the maintenance of his machines since, likewise, he cannot expect that they will bear an unlimited amount of wear and tear, restore and regenerate themselves without his constant care and toil.

A very balanced and realistic approach is needed to the problems involved in the deterioration of the human environment. It is not simply a matter of developing and applying scientific standards, norms and technologies for fighting pollution, nor of cursing industrial civilization and preaching some kind of 'return to nature.' Let us not forget that man in his 'natural state' had an average life expectation of less than 30 years, was mercilessly exposed to hunger, cold and all sorts of absolutely 'natural' illnesses and ravages — it is in the highest industrialized societies, and only there, that man can now expect on the average to live 70 years or more, and that millions — though as yet by far not enough millions — can enjoy welfare and well-being unattainable on any lower level of economic and technological development.



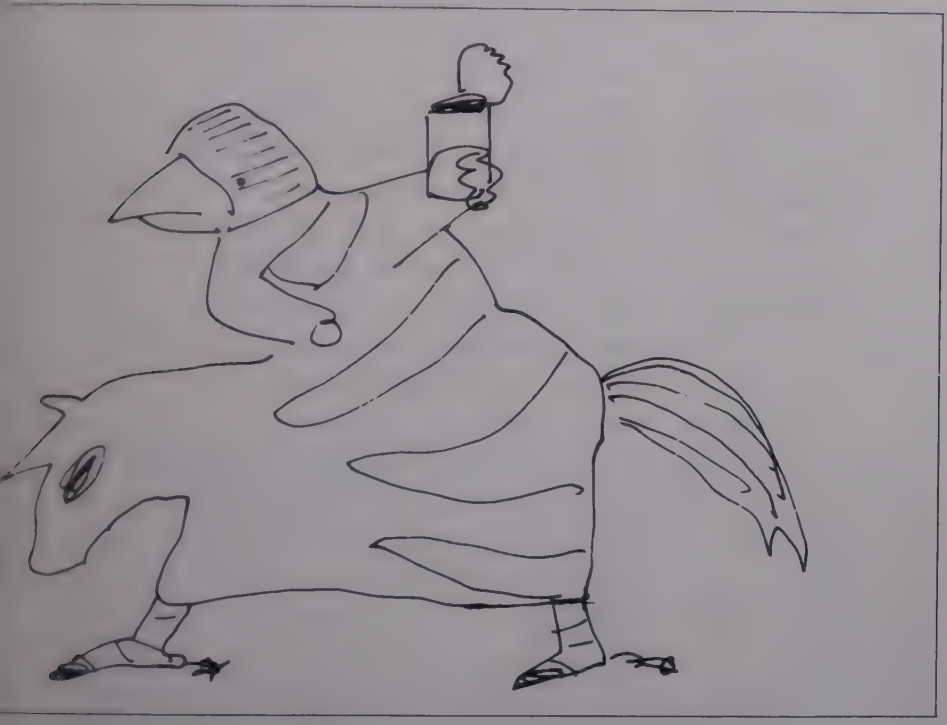
"... there simply is too little time, brain power, and public money for n

As to the development and application of scientific standards, norms and technologies for fighting pollution and all sorts of environmental deterioration, here again it has to be taken into account that man is the measure for what could and should be done: costs and benefits have to be considered in the whole context of human development.

When England developed its industry in the eighteenth and nineteenth centuries, an industry based to a considerable extent on the 'coal from Newcastle,' it could have hardly put into motion all those wheels driven by huffing and puffing steam engines had it then taken up simultaneously the task of filtering and eliminating all the soot and fumes and vapours which were blown out by the smokestacks of its primitive factories. The standards, norms and technologies for fighting the pollution which materialized in the ill-famed London fog arose out of the same industrial development that had polluted the air to such an extent. Now, this does not mean that countries which are today in the first stages of their industrial development should repeat all the mistakes the pioneers of industrial development made at earlier times and that no great efforts should be made to apply contemporary scientific standards, norms and technologies to the pre-

vention of pollution from the very beginning of industrial and urban development wherever they occur today. However, costs and benefits have to be carefully considered because excessive demands — even with respect to environmental care and prevention — can also act as brakes on development and stifle it. There is, however, no doubt that environmental considerations have to play a much greater part in development planning, especially also at the earlier stages of industrial and urban development, than has been the case up to now because the sorry experiences of the 'pioneers' must not be repeated.

Currents of air, flows of water do not respect national boundaries. Neither does animal life, vegetation, or pestilence for that matter. The treasures of the oceans and of inner and outer space are the common heritage of mankind.



...operate either in a chauvinistic or unconsciously introverted fashion..."

Although a very great part of the efforts for the preservation and betterment of the human environment and for the prevention and elimination of the damages to it must be handled within the boundaries of the nation-states, there is no doubt that colossal tasks remain to be solved and can only be solved by international action and international organization. As the President of the Ford Foundation, an institution that has long supported the environmental sciences, rightly stressed in a recent essay, one of the first tasks the international community has to undertake is to ensure the compatibility of the national systems for monitoring, collecting and storing environmental data. An intellectual consensus has to be achieved concerning the key phenomena to be observed and the quality indices to be established so as to obviate the dangers of poor and nonexistent linkages between national arrangements for collection, storage, retrieval and exchange of environmental data — data that are equally needed for planning, prevention and action on the national, regional and global scale. Then, even assuming that each nation will independently pursue research and experimentation in remedial actions, "information on work in progress, as well as on results and understandings, however tentative, must flow freely across the political boundaries" because "there simply is too little time, brain power, and public money for nations to operate either in a chauvinistic or unconsciously introverted fashion; or for countries to run up blind alleys trodden earlier by others or remain ignorant of promising approaches under scrutiny elsewhere." Finally, "when the necessary intellectual mobilization begins to yield operational applications, there will surely be an opportunity for shared international effort. The developed countries will have their traditional obligations vis-à-vis the emerging countries, and new patterns of international law and management seem likely to be required with respect to our priceless, collective, oceanic, inner- and outer-space assets," wrote McGeorge Bundy in the Saturday Review.

The Secretary-General of the United Nations stated recently that "for the first time in the history of mankind there is arising a crisis of worldwide proportions involving developed and developing countries alike — the crisis of human environment." He added the warning that "if current trends continue, the future of life on earth could be endangered."

We are not prepared

We cannot say at present that the United Nations, the whole world organization encompassing also an important number of great specialized agencies, is well prepared to cope with this crisis. True, the General Assembly of the United Nations has authorized the Secretary-General to proceed at once with the preparation of a "United Nations Conference on the Human Environment," to be held at Stockholm in 1972. As is only natural, there is hardly a specialized agency within the United Nations system which does not have a direct interest and involvement in environmental problems. However, the problem is of such overwhelming magnitude, involves so many complex political, social, cultural, economic and technical questions and such a tangle of national or sectoral interests which present themselves in so many different forms on the various levels of socio-economic development, that only an unprecedented effort of coordination and cooperation within the United Nations system itself and still more between the world organization and its member states or indeed all the nations around the world can provide a real chance for a satisfactory solution.

Maybe it is just this global character of the environmental problem, this global demand it puts to mankind, that will prove to be beneficial in the future. After all, man has acquired considerable mastery over nature on a global scale but no comparable mastery over his own affairs, certainly not within his most immediate communal or national surroundings, still less in the international context. However, the concerted worldwide political, social, economic, scientific and technical effort needed to cope with the environmental crisis may compel man to achieve just that — a mastery over natural and social processes which can ensure a sounder and happier life for all who live on this beautiful and solitary globe, the only hospitable place for man in the infinity of space. ■

Implications of the pesticide age

We are living at a unique and crucial period in time. Many of the problems which face us today have never occurred in the past, and therefore history cannot help us to solve them: we have to study and act without the advantage of past experience. The great issues of the day are essentially ecological; that is they concern the relationship of populations with each other and with their environment. For practical reasons we think of the population problem, the disease problem, the conservation problem and the pollution problem as being separate, but of course they are all connected and interact with each other. The increasing complexity of science, technology and administration makes it harder than ever to relate these problems, and yet the need to do so becomes increasingly obvious and increasingly urgent. I shall attempt here to relate one technology — the use of pesticides — to the complex of related problems mentioned above.

A number of organisms use toxic substances; grasses whose roots exude substances which affect competing species, nettles, jellyfish, spiders and snakes are well known examples of organisms which use chemicals to protect themselves or to kill their prey. For centuries human beings have hunted wild animals with poisoned arrows. The insecticidal properties of nicotine were discovered in the 17th century, but man was slow to develop chemical agents in order to control competing species. In fact, one of the first major developments was for intraspecific conflict; in the first world war poison gases were developed and used, in the second world war they were further developed but happily not used. However, the discovery of organophosphorus insecticides, which were developed originally as war gases, and also the discovery of the organochlorine insecticides DDT and BHC, and of the growth regulating weed killers, all in the second world war, led to a revolution in the fields of preventive medicine and agriculture in the years which followed it. The rapid growth in production and use of herbicides, fungicides, insecticides, rodenticides etc., which today are known collectively as pesticides, was phenomenal. When social historians get further from the past quarter of a century they will probably affirm that the development of pesticides from 1945 onward was one of the turning points in human history.

Dr. N.W. Moore *heads the Toxic Chemicals and Wildlife Section of the Nature Conservancy of the United Kingdom.*

Boon and bane

The value of pesticides was and is enormous; they have saved millions of lives and greatly increased food production and reduced the waste of stored food; but like all technological advances, they have brought new problems as well as solving old ones, so that today, at least some people believe that the disadvantages of pesticides may even outweigh their advantages.

A recent scientific symposium in Britain was entitled "Pesticides — Boon or Bane?" Of course, they are both boon *and* bane, and this has been the cause of much controversy. So great are both their advantages *and* their potential dangers that it is not surprising that the pesticide debate has been such a prominent feature of recent years. At times it has been acrimonious, ill-informed and nonscientific, but no one would deny that it is about an important issue; it is in fact central to the great ecological problem of our age. It is generally accepted that the rapid increase in the world human population is largely due to the reduction of mortality rates, and that this in turn is largely due to the control of disease vectors by insecticides. That the world has been able to feed the vastly increased human population is also due to the widespread use of insecticides and of herbicides and fungicides, although the greater use of fertilizers, irrigation and improved genetic strains has played an equal, if not more important, part. Thus, pesticides have increased the human population and have helped make the agricultural environment more capable of supporting this larger population. On the debit side, pesticides have created new pests, they have destroyed millions of organisms which are harmless or are valuable to man, and, for the first time, chemical substances used as poisons have become global contaminants. How has this come about? To understand the reasons it is essential to consider what pesticides are and what it is they affect.

For practical reasons the farmer tends to think of a pesticide as if it were a medicine administered to his crop; as with some medicines, it may have undesirable side effects. This view is inadequate and is a totally unscientific way of considering what actually happens when a pesticide is used. Unfortunately no pesticide is specific to the pest against which it is applied. Different species vary greatly in their response to the same chemical; even so, each and every pesticide application will result in the death of numerous organisms other than the pest; in other words, there are always side effects, whether or not they appear important to the man on the spot; and pesticides are bound to affect the whole

Complex ecosystems are being polluted in the name of progress

by N.W. MOORE

ecosystem in which the crop and the pest are living. Even the simplest ecosystem is extremely complex and contains many species of plants and animals. So great is the complexity of all ecosystems that very little is known about the causal factors within them, therefore, whenever a spray is used it is being applied to a system which is very imperfectly understood. There are many types of effect which occur when a pesticide impinges on the population of a species. First, there are the toxicological effects — a proportion of the population will be poisoned and others will suffer sublethal effects, which may make them more susceptible to other deleterious factors, or may affect a future generation by impairing reproduction. Some toxic effects can be delayed, as when a predatory animal is poisoned by obtaining amounts of a persistent insecticide which have been accumulated by the prey animal on which it feeds. Secondly, the normal balance of ecological relationships, for example, those between competing species and between prey and predator, are likely to be upset when the different organisms in the ecosystem vary in susceptibility to the pesticides, as they always do. For example, the mosquito *Anopheles hispaniola* and three other species benefited at the expense of *Anopheles labranchiae* when Sardinia was sprayed with DDT in order to eliminate malaria. Indirect ecological effects of pesticides have had important economic consequences, for example, large sums of money now have to be spent

SPRAYING DDT OVER KINSHASA IN THE CONGO TO PREVENT MALARIA
No longer so simple

annually in order to control red spider mite and related species; before pesticides were used extensively, these animals were adequately controlled by predacious mites and other wild predators, but nonselective sprays have reduced the populations of the latter to such an extent that those of the red spider mite were released from normal control and so became pests.

A new environmental situation

All pesticides are liable to produce problems but since most substances are broken down quite rapidly into harmless metabolites, these effects are usually local and transient. The power of recovery of most ecosystems is strikingly great: it can be assumed that this is a function of complexity. However, organochlorine insecticides produce quite a different sort of problem because they are both highly persistent and soluble in fat. These characteristics enable them to spread outside treated areas and to accumulate in the bodies of animals and hence in food chains. Persistent organochlorine insecticides have been detected in the component parts of all the major ecosystems: on land in soils, plants, insects, birds and mammals, and in rivers and the sea in muds, water, fish and fish-eating birds and mammals. Many vertebrate animals have been analysed for these chemicals and nearly all of them have contained detectable amounts of DDT and its metabolites and of dieldrin; many also contained heptachlor epoxide and isomers of BHC. The specimens have contained pesticides even when they were obtained from remote parts of the Arctic and Antarctic. Therefore, there is today a totally new environmental situation — practically all life on the earth is now in contact with synthetic organic toxins. The extent to which these substances are having effects depends on the amounts obtained by the different organisms; the quantities in rainwater and the sea are extremely low and in some cases are undetectable; they are extremely unlikely to have biological significance as such, but pesticides at these very low levels can be significant if they become concentrated by living creatures. Organomercury fungicides also become widely dispersed and accumulate in food chains; increasing concern is being voiced about the abnormally high levels of mercury found in wildlife in several countries.

To understand the biological significance of environmental contamination by pesticides, many toxicological and ecological data have to be collected and assessed. In general, the animals which have obtained the largest amounts of persistent compounds have been the most affected, as one would expect. They belong to two classes: first, those animals which live in sprayed areas and so receive large doses directly or by eating heavily contaminated food, and secondly, predator species at the ends of food chains. Local casualties may be considerable but they do not appear to have caused serious damage to most species. However birds of prey, especially those which feed on other birds, such as the peregrine falcon and sparrow hawk, have been very seriously affected by acute toxic effects. In addition, organochlorine insecticides have been shown in the laboratory to produce a number of sublethal effects on birds, including the thinning of eggshells, delay in ovulation, histological changes in the thyroid and effects on steroid hormones. At least some of these effects, notably the thinning of eggshells, have occurred widely in the field in both the United Kingdom and the United States and elsewhere. In some cases there is good evidence that the sublethal effects have caused, or could cause, population declines quite apart from those due to acute effects.

Economic damage

At the present time one can conclude that several species of birds of prey in the northern temperate regions have been seriously affected by persistent organochlorine insecticides. It would be rash to say that no other species have been affected by these substances, but there is not conclusive evidence that they have been. On the other hand, the existing levels of organochlorine insecticides in many animals, including very sensitive freshwater and marine species of invertebrates, strongly suggest that a moderate increase in contamination by these substances throughout the world could put many species in jeopardy, including those of great economic importance, for example, the food organisms of commercially exploited fish. Thanks largely to the studies on birds of prey, the world has been alerted to great potential dangers, and many nations have taken practical measures to reduce the amounts of organochlorine insecticides used. In some countries the levels in the environment of these substances are no longer increasing and may actually be falling, and so possible disasters have been avoided.

The present time is unique

We have just noted that the study of relatively rare and economically unimportant species of birds of prey provided an early warning of very considerable potential danger. This raises the whole question of conservation; again the present time is unique; for many centuries man has had immense effects on the other inhabitants of the earth, but despite his destructiveness and his abundance, the vast majority of animals and plants which existed in early historical times have continued to exist. This is because large areas have remained virtually untouched by man, and because agricultural and pastoral landscapes have still provided suitable habitats for many species. Today, due to the rapid increase in man's population and to new technologies, the wildernesses are rapidly disappearing, and under intensive agriculture, farmland is becoming less and less suitable for most wild species. In the past we had wildlife without planning for it, but very shortly we will only have it if we plan to conserve it, in other words, if we spend money on it. This is forcing conservationists to clarify their aims and to attempt to define the value of wildlife. In practice wildlife is conserved for a variety of different reasons — as a source of food, for greater efficiency in agriculture, for sport, for scientific and educational reasons, for attracting tourists from other countries, and last, but certainly not least, for the immense pleasure wild plants and animals give to peoples of many countries and cultures throughout the world. As man becomes more numerous his appreciation of his environment and of other

species tends to increase, and he becomes more aware of what he may lose. Appreciation of wildlife is becoming one of the most accurate indicators of sound cultural development.

Implicit in all conservation practices is the attempt to maintain biological diversity for the present and the future. Conservation is one of the few activities in which specific actions are undertaken now on behalf of future generations. Human societies have always varied greatly in the extent to which exploitation has been balanced by concern for future productivity; some have created deserts while others have maintained ample resources. However, the implications of the human population explosion and of the destructiveness of some agricultural and industrial technologies should be forcing every responsible person to have a greater concern for husbanding the world's resources; too few yet realise that these are very far from being limitless.

International aspects

The discovery that organochlorine insecticides had become global contaminants, and in the case of a few species, were already harming populations over very large areas of the earth's surface, was valuable in that is showed that the earth's biological resources could be affected by unconscious pollution as well as by conscious exploitation. So, when polychlorinated biphenyls, which are industrial compounds used in the plastics and insulating industries, were found recently to be present in wildlife in many parts of the world, no one needed to be told of the significance of the discovery because they had been alerted by previous experience with DDT. Widespread interest in pollution problems became particularly manifest in 1969, two years following the Torrey Canyon disaster,* the year of the endosulphane spillage in the Rhine and of the seabird wreck in the Irish Sea. It is extremely encouraging that an increasing number of governments are concerning themselves with research on pesticide and other pollution problems and with action to prevent damage in the future. Also, throughout the world people are beginning to realize that pollution problems must be tackled internationally as well as nationally. There is a welcome discussion about these issues in the great international agencies such as FAO.

The needs of different countries vary greatly. Everyone would seek to reduce environmental contamination by dieldrin and DDT or indeed by any other toxic substance, but whereas some countries

PESTICIDE ON BAGGED PRODUCE
Danger vs advantage

can restrict the uses of these substances for the benefit of themselves and the world community, others cannot possibly do so until adequate substitutes have become available. Nevertheless, much could be done now to increase the efficiency of pesticide use and to decrease avoidable damage; much is already known, but the information is not always available to the people who most need it. New pests and resistant strains of old ones are being produced unnecessarily as a result of unscientific crop protection. Endrin, a compound which is exceptionally toxic to fish, is still being used in rice fields where fish are an important source of protein for the local inhabitants. Effluents containing appreciable amounts of pesticides are still being discharged into rivers and the shallow seas which also support important stocks of fish. The reasons for all these different forms of misuse are obvious — the excessive zeal of some chemical salesmen, inadequate labelling of some containers, some complacency among national and local authorities and sheer ignorance. Some of the developmental problems are more radical. For example, it does not pay industry to look for and market specific pesticides, or to study new methods of integrated pest control, when these reduce the amounts of pesticides sold, and therefore reduce profits. So, only governments can sponsor adequate research on specific pesticides and integrated control effectively.

Much remains to be done before we can obtain the most efficient use of the pesticides which are already available. Some methods of use which are current today seem naive and dangerously inefficient; in a few years they may seem reprehensible. The side effects which have caused a new agricultural problem and harm to wildlife have been regrettable, but I believe that they have had very great value in focusing attention on the real nature of the pesticide problem, which as we have seen is part of the much larger ecological problem which mankind faces today. If we pursue a more critical approach to pesticides, there is no reason why they should not save more lives and increase food production further, while at the same time, we should be able to reduce the damage done to acceptable levels. But if we do not heed the lessons learned during the last few years, and above all do not connect the component parts of the population/environment problem, we shall deserve what we get. ■

** The Torrey Canyon, chartered by the Union Oil Co., California, ran aground off Cornwall, at the western tip of England, on 18 March 1967 and caused the greatest beach pollution damage on record. In addition, detergents used in the clean-up efforts severely damaged fish, molluscs and marine plants. Birds died by the thousands, choked by oil. By 9 April the oil had reached the French coast of Brittany. Two years later the Union Oil Co. settled out of court with the British and French governments for $7.2 million which was divided equally between them.*

The case of DDT

by RAY VICKER

Opponents of DDT in the current campaign seem to have lost sight of the fact that all pesticides have some adverse qualities. Measured against these are the benefits possible through their use.

In the United States, Canada, Sweden and other developed nations one hears dire tales about DDT, how it paralyzes fish in lakes, how it flows to the sea where it kills plankton, how bird life suffers from it. Little is said about how DDT saves millions of human lives through the World Health Organization antimalaria programme, or how DDT helps farmers in developing lands to control crop-destroying pests.

In India alone, DDT helped reduce the incidence of malaria from 75 million to five million in a decade. In the Indian subcontinent, insects eat 15 to 30 percent of all farm crops each year. So a massive drive is under way seeking to double the area of cropland protected by pesticides. That drive alone could bring India an extra 1.4 million tons of rice, 100 000 tons of groundnuts, 65 000 tons of sorghum, 250 000 tons of sugar, 46 000 tons of maize and 200 000 tons of potatoes each year.

"Do we save the lives of birds or the lives of human beings?" asks Ernst W. Nagelstein, a consultant to the United Nations. Adds he: "It's true many birds will never sing again if the use of pesticides isn't brought under control. But, millions of human beings won't live to hear the songs of birds again if chlorinated insecticides are brought under a total curb."

DDT, of course, is the main chlorinated insecticide.

Undoubtedly, more attention must be given to man's pollution of the land and atmosphere. Undoubtedly, too, more research should be devoted to the entire question of pesticides before jumping to conclusions about their uses. It might be a good thing, also, if that research were directed by people who either are from developing nations, or who are interested in helping those nations.

The campaign against DDT certainly raises some disturbing questions among people who know and understand the problems in developing countries. Among those questions: Is it right that economies of developing nations be controlled by emotional outbursts in developed countries? Do people in developing countries understand the issues involved? Can adverse effects of pesticides be minimized without banning their use entirely? How can research in these problems be conducted so as to focus attention on requirements of developing nations rather than upon ecological fears of developed countries?

A potent killer

Such questions suggest ways of introducing sanity into the current hysterical campaign against DDT and related compounds.

First, it would appear that indiscriminate attacks on pesticides should be resisted by developing nations.

Second, the situation should be publicized in developing nations so that citizens understand what is involved.

Third, integrated pest control techniques should be promoted to minimize adverse effects of chemical residues.

Fourth, research into problems of developing nations should be supported wholeheartedly, with these nations playing a more vital role in that research.

Superficially, attacks on the chlorinated insecticides by the ecological crusaders may seem righteous and worthwhile. DDT indeed is a persistent and powerful chemical. After being sprayed on crops and habitations, it filters into soil or water to remain effective for months, a potent killer for many insects and minute forms of life.

But, it is this very persistence coupled with its effectiveness and low cost which makes DDT and other chlorinated compounds so valuable in developing nations. DDT, developed in 1939 and in wide use since the second world war, has never been matched in the intensive research for chemicals used to control a wide variety of pests afflicting crops and forests, says Dr. C.H. Hoffman, an official of the United States Department of Agriculture in Washington.

"The amazing thing is that a compound which was in a sense the first crack out of the researcher's box should still meet many comers in today's fierce search for pest-killers which are safe to handle, cheap and effective."

The United States President's Science Advisory Committee of 1965, for instance, reported that for every American dollar invested in pesticides for crop protection, farmers in the United States saved between $4 to $5 worth of crops. No comparable figures are available from developing nations. But, it might be well to note that most of these nations lie in the tropical and equatorial belts where insects are more serious a problem than in the United States.

Relatively, therefore, benefits of pesticides to developing nations probably are far greater than those noted in a rich country like the United States.

In the public health area, DDT's benefits are even clearer. "DDT has been instrumental in controlling some of the most important vector-borne diseases of man,"

Ray Vicker *is News Editor of* The Wall Street Journal *of New York.*

It shows the need for an international non-commercial crash programme of pesticides research

PESTICIDE DUSTING OF COTTON IN LATAKIA, SYRIA
No cheap substitutes

says Dr. M.G. Candau, Director-General of the World Health Organization in Geneva. " The concept of malaria eradication rests completely on its continued use. Limitations on its use would give rise to grave problems in the majority of developing countries. "

When benefits of any compound far outweigh the harm it may do, man certainly should beware of excommunications. When those benefits accrue to developing countries, there is a double reason for seeking sanity. Rich nations can use expensive substitutes for DDT. Developing nations cannot.

Five to seven years

DDT costs about 15 American cents a pound and is easy to apply. Most suggested substitutes cost a dollar or more a pound.

" There just is no inexpensive substitute for DDT, " says an official of J.R. Geigy S.A., Basel, Switzerland, the chemical company which first introduced DDT. A Swiss chemist, Dr. Paul Mueller, won the Nobel Prize for his work with DDT in 1948, a prize based on the fact that millions of lives were being saved through his discovery.

Checks with chemical companies in Europe and America such as Britain's Imperial Chemical Industries and Fisons, Ltd., the Federal Republic of Germany's Bayer, America's Du Pont and Switzerland's Geigy indicate indeed that no cheap and effective substitutes for DDT are on the horizon.

It costs a company $3 to $5 million and five to seven years to develop a new chemical compound. This means that chemical concerns concentrate on those items which offer the best prospect for a profit return. Moreover, the anti-DDT

crusaders cause companies to be wary about spending a lot of money on research and development for new pesticides. An official of one company, who understandably does not want to be named, says: "If DDT is banned, you can be sure that related chemicals will be attacked, too, and in the same way. We have to take this into consideration when planning our research."

Of course, there are substitutes on the market now, provided that people are willing to pay the price. Many a farmer in Mexico, India, Brazil or other developing countries does not have the money to make such shifts.

The ironic thing, too, is that many of these substitutes are much more dangerous than DDT. Despite all the clamour about DDT, World Health Organization doctors insist that no research ever has definitely proved that DDT is harmful to human beings. Certainly, the compound under some conditions can be harmful to rats, to birds and to other forms of life. It could be harmful in some ways to humans. "To date, there is no evidence, however, to indicate that DDT is dangerous to humans," says Dr. Frank C. Lu, chief of the food additive section of WHO.

Dangerous substitutes

Not so with one suggested DDT substitute, parathion. This compound is so deadly that mishandling can cause catastrophe. In Algeria, so many people were dying through such mishandling that the government banned use of the chemical in agriculture. In 1967 in Mexico seventeen people were killed and 600 made ill when parathion contaminated bread supplies.

Is this the type substitute which anti-DDT crusaders think should replace DDT in developing countries? It might be well to note, too, that packaging of many chemicals has descriptions and explanations written in English, German or other languages of developed countries. Moreover, in many developing nations, the man who might use the pesticide may not know how to read even in his own language. Thus, it is imperative that any DDT substitute be not only inexpensive but harmless, or relatively harmless, to human beings, too.

It is evident that any analysis of the pesticide situation certainly indicates DDT is vitally necessary for the welfare of developing lands, and this is likely to be the case for some years ahead. No adequate substitutes are available.

Accordingly, one might conclude that developing countries should ignore the campaign against DDT in developed countries, and everything will be all right. That attitude overlooks some commercial and political facts of life.

The banning of DDT in industrial nations can be expected to lead to more stringent inspection of foods coming into these countries. Developing countries continuing to use DDT may then find their food exports increasingly discriminated against.

Then, there are the political consequences. Authorities in rich countries will be telling their farmers that DDT is dangerous and must be avoided. Yet, in developing lands, farmers will be using those same pesticides. In such a situation, many people in developing countries may ask the question: If DDT is bad for people in rich countries, isn't it bad for us, too?

If the banning then spreads to developing lands, dangerous substitutes might be forced into the hands of farmers and health workers. Needless deaths through mishandling then might occur.

There could be additional political consequences, too, if DDT becomes another wedge in the cleavage between the have and the have-not countries.

People in the poor lands undoubtedly would be much more reassured if rich nations were putting energy into finding suitable pesticide substitutes for DDT rather than trying to restrict its use or ban it entirely.

Necessity for such research is emphasized by nearly everyone cognizant of the problem. Even if there were no campaigns against DDT, the search for substitutes should be much further along than is the case. Many insects are developing resistance to DDT.

"Resistance is the greatest single barrier to the completion of eradication programmes and to the maintenance of continuous control in the field of public health pests," says Dr. Rajundar Pal of India, a biologist with WHO. He believes that the only practical alternative is the development of new insecticides that are both safe and cheap.

The ideal situation would be for DDT to be phased out over a period of five or ten years, while intensive research is devoted to finding substitutes. This research is so woefully inadequate at the present time that some foreign aid experts feel a crash programme should be launched. Such a programme could call

AN EXPERIMENTAL CR

for creation of an international consortium to finance a pesticide research effort.

Major industrial corporations in developed lands are becoming increasingly aware of their responsibilities toward developing nations. Undoubtedly, support from some of these companies could be enlisted in a crash programme to find new and safer pesticides which also would be cheap. Such corporations might be induced to establish manufacturing facilities in developing countries so that these nations will have better control of the pesticides they actually need.

Consortium research could focus not

only on pesticides but also on other phases of development work, too. Take farm implements, as an example. Sometimes major international farm implement manufacturers are criticized because they devote most of their research to developing machines for farmers in prosperous countries, rather than on creating cheap and uncomplicated machines for farmers in less developed nations. Companies naturally are most interested in those areas where sales and profits are highest. But, developing nations undoubtedly would benefit if at least a few farm machinery development programmes would focus attention on requirements of farmers in developing countries.

Moreover, there are numerous other gaps in development aid research which are not being filled by any agencies. Ironically, agencies which have the most to do with handling developing nations assistance are among the most backward in fostering research directed at problems of those needy nations.

Today, a miracle rice yields bumper crops in the Philippines and southeast Asia, providing hope for many food-short nations of the globe. The variety was developed by the Ford/Rockefeller-financed International Rice Institute at Los Baños, Philippines.

Najaah wheat which, because of its greater number of ears, survives on dry lands where other wheat dies for lack of moisture, was selected by FAO and developed by researchers at the American University of Beirut, Lebanon.

So it goes. In one area after another those agencies directly concerned with foreign aid have left research to philanthropic people, to universities and to regional or national organizations which frequently have little money for such tasks. Unfortunately, too many gaps do appear in that research. Moreover, better liaison is needed so that findings of the individual research agencies can be applied quickly to developing countries where the need for solutions is greatest.

IGH YIELDING RICE BEING HARVESTED IN JOGJARKARTA PROVINCE, JAVA
pesticides have not kept pace with the seeds

The current furore over pesticides underscores another research gap which merits immediate attention. This has to do with research into integrated pest control; the rational manipulation of all factors influencing the incidence and prevalence of pests (including physical, chemical, cultural and biological control methods).

In Greece, for instance, where the olive fly does up to $40 million worth of damage annually, experiments are under way in the mass rearing of parasites that attack the flies and disdain the olives.

Natural warfare

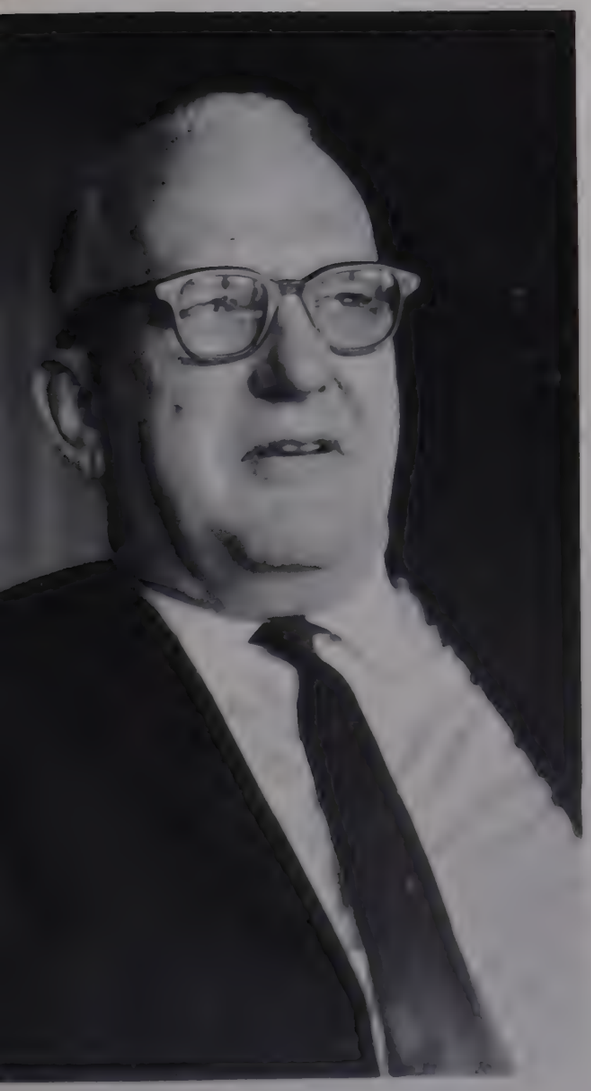
Sometimes, crop scheduling can be revised to outwit insects. If the crop matures before the time when a certain insect reaches its annual population peak, predatory onslaughts of that insect may be minimized. One American drug company has developed a potent sex lure compound which attracts female cotton boll weevils. Experiments indicate the compound may bait traps which could attract and trap the female insects, eliminating the need for the heavy applications of DDT often used to control such insects.

In California, the leaf hopper Dikrella is now virtually immune to DDT. Yet this hopper is a major pest in grape vineyards. Ecologists found that a tiny wasp is a deadly enemy of the hopper. By breeding and releasing these wasps, which are harmless to man and crops, the Dikrella hopper is being controlled at a fraction of the cost of the DDT applications used heretofore.

World wide, farm chemicals and public health pesticides can contribute substantially in the fight against malnutrition and eradicable diseases. Even today, after years of malaria eradication work, 2.5 million people die from it every year. Moreover, with only two percent of the world's surface suitable for agriculture, the time is arriving when every ounce of food which can be squeezed from that land will be needed by an exploding population which is expanding 2½ times a life span.

The world needs sanity, not emotional crusades, as it faces the problems of malnutrition and disease. ■

Needler: pollution prevention is costly...



A. W. H. NEEDLER
Deputy Minister of Fisheries and Forestry, Canada

ceres What are the main sources of pollution of the oceans and inland waters?

Needler: It's a very big question and one has to know what one means by pollution because there is nothing, there is no substance which is not damaging if it's introduced to confined bodies of water in large enough quantities and, likewise, there is no substance so poisonous that waters can't absorb in some minute quantities.

People look at pollutants in categories, quite naturally, and think of domestic sewage as one of them. Up to a certain level, domestic sewage is simply a fertilizer. Past that level it uses up too much oxygen and will lead to fish being killed or even finally eliminated. This is one large source of pollution but it is one that can fairly readily be handled if appropriate technology exists. Another sort of pollution is the direct effluent of industrial plants. We had in Canada, for example, over the last year, crises where industrial effluents were damaging fisheries seriously. One was a case of contamination — this is quite readily remedied. At least we can get rid of the source, but we don't know how long it will take the environment to recover. Another one was a case of elemental phosphorus being introduced by an industrial plant and this, too, was cleaned up at a cost of perhaps a million dollars. And there are all kinds of industrial products.

There is another class, however, which is quite important, very important to my mind, and that is the pesticides; especially the pesticides which persist. In my opinion, it should not be legal to use any persistent pesticides, any pesticides which last for, say, a number of years. Because pollution from this source has not only been increasing, it seems to have been increasing at a growing rate, and this must be arrested if we are going to survive.

ceres While the rich countries can afford to ban persistent pesticides and substitute them with nonpersistent ones, the developing countries cannot: there is a great lag in research for nonpersistent, effective and cheap pesticides. Would you care to comment on that?

Needler: Well, in the first place, of course, more research is needed to develop nonpersistent pesticides and I am sure that more effective and cheaper ones will be developed. However, I think it's pretty hard for us to estimate cost against health. Essentially, the pesticide problem, DDT for example, has two aspects. One is its direct effects on human health; while these are not very quick or drastic it seems that there are some, enough for health authorities to say that food should not contain more than a certain amount of pesticides. The other aspect, which is extremely dangerous, is that some of these pesticides are extremely toxic to crustacea which constitute most of the zoea plankton which are one step between the microscopic plant and the fishery product that we get in the form of fish or squid. We wouldn't have to go too far to be in a dangerous range in some areas in this connexion, and then it would become perhaps rather soon a matter of survival for some communities. One shouldn't be too panicky about this, but the only reason one shouldn't be panicky is that people are aware of it. I believe, from contacts I've had with some developing countries, that they are just as anxious to have the same protection to their health that developed countries have: I don't think any suggestion that they should go and ape the developed countries in pollution would find acceptance.

ceres Offshore oil drilling has resulted in considerable pollution damage. But for developing countries the prospect of finding petroleum deposits offshore or anywhere far outweighs fear of pollution. If you were the minister of development of a country negotiating with an oil company for offshore drilling rights, how would you proceed to protect your country from damage?

Needler: That's another big question. In the first place, I would want to be sure that every precaution was taken against oil spills. I would want to be sure that the resources were ready available and preferably financed, ultimately, by the oil industry itself, for clean-up operations. And also that the oil company would take complete financial responsibility for damage.

ceres When you say the resources for clean-up operations should be available in advance, are you suggesting the creation of clean-up funds, that is to say, a special budget reserved for oil spill and other damages?

Needler: Yes, I would suggest this, but I mean a little bit more than that. I think the equipment has to be available too. Now we haven't gone very far anywhere in the world in this direction and I would say that we are in a stage of very rapid development over the means of handling oil spills. And there is plenty of pressure to see that these means are developed. I don't know whether they will ever become completely adequate, in the sense of being able to take care of oil spills without any damage whatsoever. But I am sure that they will be able to keep the damage much lower than it otherwise would be.

But the financial responsibility has to be there too and I believe that since the oil damage is a cost to society, society is really paying this cost in order to get oil. I think it is more economically sound to couple these two costs right at the source, in other words to have the companies completely financially responsible for damage, for clean-up operations and for compensation.

ceres Detergents have been used to clean up massive oil spills. But is is true that this cure may be as bad or worse than the illness and that detergents merely cause another form of pollution that is less evident to the eye?

Needler: Oil spills have not, as far as we know, caused a great deal of damage to fish or shellfish except those which are in rather shallow water in a narrow zone. Now in some of these cases I think it has been pretty well shown that detergents used to clean up oil have actually been more damaging. In Canada, in the case of the oil tanker Arrow, which ran on a rock off Nova Scotia, the Government is attempting to clear up the spill without the use of detergents.

ceres What are they using instead of detergents?

Needler: Mechanical means. They have even developed an apparatus for skimming the oil off surface water, which can be done in calm weather: it was bunker sea oil which is rather thick.

ceres In view of the industrial countries' awareness today of environmental problems, do you think that these countries, or the agencies in which they are influential, may use pollution or other environmental dangers as reasons for not approving grants and loans for certain kinds of projects or industries in developing countries?

Needler: I don't know whether they will but I think that they should. At least to this extent, that funds that are provided for development should be used with a minimum amount of danger to the communities where the developments take place; and this means that the agencies should insist on very intelligent and thorough assessment of dangers as well as benefits from any development.

ceres Industrial antipollution devices are relatively new and expensive. Might not many developing countries prefer to spend their hard-to-come-by foreign exchange on acquiring as much industry as possible, without worrying about unproductive and costly devices? Might they not consider protection against pollution luxury at this point?

Needler: Only if you consider survival a luxury . . . and perhaps it is. No, I believe that the awareness of the dangers of pollution is spreading. If the idea were allowed to grow in countries that are on the receiving end of foreign aid that their people don't deserve the same kind of protection as the citizens of the rest of the world, they would resent that kind of foreign aid as being essentially obsolete, defective and second rate.

ceres Can you conceive, Dr. Needler, of any kind of international master plan being drawn up for the control of pollution of the world's oceans?

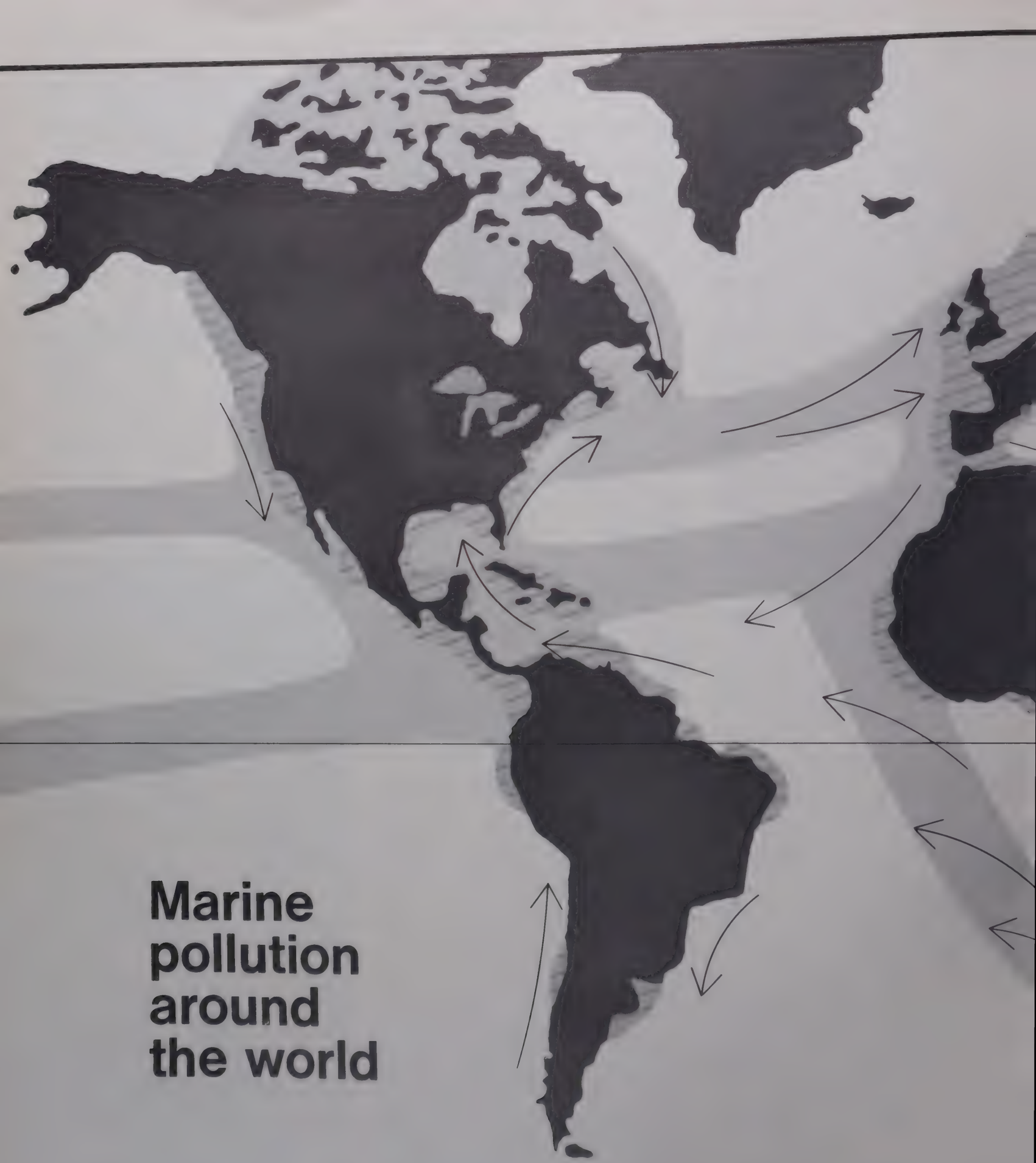
Needler: I don't really believe in master plans, except as the background or framework in which there are energetic and flexible activities. So there is not going to be any single technique or any single procedure for controlling pollution all over the world. But I do believe that international organizations will have a role to play in the stimulation of research, in the flow of knowledge on pollution control methods. And, indeed, in what you might call world public pressure for control of pollution. I think there will probably be, before the turn of the century, a number of international conventions with some teeth in them for controlling pollution; but it may not be one single, very simple plan.

ceres You said that developing countries are becoming aware of the dangers of pollution and environmental disturbances just as the industrial countries, and that therefore they should not be sold short about pollution control.

Needler: I think that the developing countries may have, sometimes, a great hunger for industrialization. But one must remember that in the developed countries there are vested interests in industries which are causing problems; and yet in the case of the developed countries, there is now growing an overwhelming public opinion against dangerous pollution which is forcing their industry to take preventive measures. I'm not trying to draw a picture of that sort of a callous industrialist who doesn't care what happens to people. Industry itself doesn't want to be cast in that part. But in the long run, with the present growth of communications, it will be just about as easy to awaken the populations of developing countries to this danger as it has been in the highly industrialized countries, where public opinion is now insisting on clean-ups.

ceres Is it not possible that this awareness in developing countries will retard industrial development?

Needler: Preventing pollution will be one of the costs of industrial development. But this will apply to all countries and I don't see that it should necessarily rebound to the disadvantage of the developing countries. The highly industrialized countries are facing very high costs as a result of pollution control pressure from the public. If these costs were not met by corresponding costs in the developing countries, you could have a sort of exodus of industry which would lead to industrial development in developing countries, and some temporary wealth there and then some damage. But this would be balanced in the long run. ■



Marine pollution around the world

Source: Michael Waldichuk, Fisheries Research Board of Canada, and Leif Andrèn, FAO.

Continuing pollution, locally accumulating
Intermittent pollution
Potential pollution by oil or noxious cargoes along shipping lines
Some significant ocean surface currents

Diop: ...but it shouldn't reduce the amount of aid

BABACAR DIOP
Director General,
Senegalese National Enterprise for Fisheries Equipment

ceres Pollution has become a major problem in industrialized countries: it is indeed one of the consequences of their industrialization. This being the case, what do you think of the desire of third world countries to industrialize in spite of such a danger?

Diop: There is undeniably a certain contradiction here. In our countries development means industrialization which in turn means pollution. Still, we are convinced that it is possible to fight pollution. The trouble is that up to now people have neglected to do so. Pollution has been arousing interest only as of late, whereas it has existed since the world was created. That is the heart of the problem. Thus there really isn't a contradiction after all; the fight against pollution has simply lagged behind the rate of industrialization. That, I believe, is the correct way to look at the problem.

There are a certain number of steps to follow in solving any problem. With respect to pollution, we must first of all find out exactly what it is, what it consists of. What are pollutants? Which ones are discharged into the sea and which ones flow into inland waters? Here we are faced with serious problems and I believe that action is being taken on different levels and in various fields to come up with the kind of solutions and to enact the kind of measures needed to efficiently combat pollution. But that is a long way from saying that we ought to slow down industrialization in order to avoid finding ourselves with a pollution problem too big to cope with. As far as we are concerned, we will not do such a thing. No, what is needed, as soon as pollution dangers are detected, is to enact the necessary measures to fight them. We don't believe that there is a real contradiction between industrialization — so necessary in developing countries to permit the population to attain an acceptable standard of living — and the consequences of industrialization, that is, pollution.

ceres Oil pollution caused by passing tankers as well as by off-shore drilling has already affected the coastal regions of certain developing countries. Hasn't it created difficult problems on a great number of levels?

Diop: It is indeed a very delicate question. The role of oil in pollution is undeniable. As you mentioned, the huge cargo ships first of all, and then the oil prospecting along the continental shelf, are the contributing factors. Still, oil is generally considered essential to development; every country would like to have a few wells inasmuch as oil sales are at present the prime source of foreign currency. But in view of what we know of oil pollution dangers (for example the Torrey Canyon disaster*), the problem is rather one of finding a way to conduct oil prospecting, necessary to industrial development, hand in hand with the fight against the unfortunate consequences of such prospecting.

I feel that as far as oil is concerned the problem is relatively simple, since effective ways to fight oil pollution have been found. What happens is that the tankers pollute the sea then move on. The damage caused is only noticed later. I believe however that it would be quite easy, in this specific case, to combine safeguard measures with prospecting procedure.

ceres The continent of Africa is at present the least industrialized. Is the problem of inland water pollution felt there nonetheless? Are there to your knowledge any concrete examples of it in any part of Africa?

Diop: The problem, there, is indeed a serious one, although not so much in my country which, alas, has not been terribly fortunate with respect to industrialization. In the forest countries, however, the problem is capital and oftentimes crucial, as there the kind of mistake I referred to earlier has been made. Pollution risks were ignored when factories were constructed. That is why today in those countries, just as in highly developed ones, we are reaching the point where even drinking water supplies are threatened, both from a qualitative and quantitative standpoint. The dangers are real and present ones not just possibilities, and this is especially true in those countries in which wood as a raw material has been exploited to excess, for many years.

ceres In industrialized countries

* *See footnote p. 29.*

the public is now aware of pollution. Governments, there, are quite probably going to pass stiff laws compelling manufacturers to produce 'cleanly.' The cost will obviously be very high. Perhaps, in that case, the industrialization which developing countries desire so much will take place a lot faster than was expected, if certain industries, especially those which pollute a great deal, should decide to move to certain countries where antipollution legislation has not yet been enacted, that is, quite obviously to certain third world countries. What would be your reaction?

Diop: If that theory were to hold true, it would certainly be a very happy day for us, and I don't hesitate to say so. It took some disasters to awaken public opinion to the insidious problem of pollution. Because pollution *is* an insidious problem. Those pictures we have all seen after the Torrey Canyon disaster show but a limited aspect of pollution, and they did awaken public opinion. But the real danger is elsewhere, and it is much more serious in that it is invisible; those pictures do not portray the real phenomenon of pollution and its consequences. Yes, of course, several countries are taking preventive measures and, as you were saying, these measures may influence production costs in their industries. This in turn may encourage their manufacturers to move their factories to developing countries where the lack of legislation makes it possible to do almost anything. But in the final analysis the problem should not be looked at from that angle. After all, these countries are now present in all the international organizations, and pollution is an international problem calling for international solutions. Enacted measures will be applied everywhere — "unfortunately" for us, if you permit me to say so, as it would be quite fortunate for us to be able to draw new industries and thus speed up our industrialization. Despite all that, I think it would be best to look for ways to increase our rate of industrialization elsewhere than in the lack of antipollution legislation.

ceres Given the enormous expenditures that the governments of the rich countries will have to make to clean up their own environment, isn't there the danger that the already insufficient aid that these countries grant the third world may decrease even further?

Diop: This is an extremely important question. We know today that pollutants travel everywhere. Experiments in this field have shown that pollutants from one continent may reach another. Solving this problem requires therefore international measures. But that is not at all the same as to say that such measures can be considered a sort of compensation, in other words, a justification for transferring a part of the aid now given third world countries to the fight against pollution. That would seem to me quite a biased way to look at the problem. I believe that it is absolutely necessary to fight pollution, but at the same time pollution may bring with it certain 'advantages.' You made an ironical remark a little while ago about the participation of industry in this fight: requiring industries to produce 'cleanly' means requiring them to make special financial efforts. But these expenditures, instead of being made in that narrow field, could be channelled toward international aid, with the individual industries thus participating at the international level, for they are concerned by the problem as much as the population in general is. It would therefore be possible to create new sources of funds to help developing countries, in addition to those existing at present. I believe that by such measures it would be possible to fight pollution without detracting from aid to the third world.

ceres Have any steps been taken in this field? Has the international scientific community had any ideas or suggestions concerning a world plan against pollution?

Diop: Yes, indeed. A great deal has been done since the international organizations have taken up this problem. FAO, on its own initiative, is organizing a technical conference on pollution in Rome which, I believe, will take place this year in December. There is already a joint group of experts studying the scientific aspects of marine pollution, created under the auspices of IMCO, which is the Intergovernmental Maritime Consultative Organization sponsored by Unesco and the World Meteorological Organization, in collaboration with FAO. The International Atomic Energy Agency has also shown interest in the question, and this working group has promoted fruitful research, as well as interesting exchanges of views; the results of the latter have been communicated to the various governments with the purpose of suggesting specific measures to enact. With respect to IMCO, a resolution has been adopted concerning the specific problem of oil pollution. Commercial ships, according to the resolution, are not to unload in certain places. This obviously raises a governmental problem inasmuch as there is no police body in this sector. Such resolutions are aimed at member states and it is up to the states to enforce them.

All this is to say that international measures have already been taken to reduce pollution. You are also aware that the 1970s are going to be dedicated to the study of the sea, and that during those ten years the United Nations is asking the competent international bodies to organize a long-term research programme. An important part of this programme will be dedicated to marine pollution. Last year, in March-April, a working group was brought together on the small Italian island of Ponza. It was composed of the World Meteorological Organization, the Scientific Committee on Oceanic Research (SCOR), and the Consulting Committee on Sea Resource Research (CCRRM), that is to say, the most eminent specialists in the field of fisheries and in particular in the field of production. They did an excellent job, to my way of thinking. Their work was followed up by the Intergovernmental Oceanographic Commission and transmitted to the Economic and Social Council of the United Nations. It will therefore be included in the long-term programme of which we have spoken. What remains is to put it into practice. Resolutions have been adopted concerning the possibility of dividing the work among existing laboratories, so that a solution to the pollution problem may be rapidly found. This is just one more aspect of its internationalization, which is indeed the only possible approach to pollution. ■

The earth's dwindling resources

Man's very survival may soon depend on his ability to effectively develop and wisely manage the world's dwindling supply of natural resources. Space photography, that is, photography of the earth's surface, when taken from earth-orbiting spacecraft, can give resource managers a clearer picture, both literally and figuratively, of the agricultural crops, timber, forage, soil, water, minerals and other natural resources which they seek to manage. It should be considered therefore as an important aid to development, and a maximum effort should be made, in the decade of the seventies, to effectively use space photography in the development and management of these resources.

Resources demands rising

How can this be done? A series of space and aerial photographs will show the way in which they can be used as a novel instrument for progress.

Figure 1 shows the human population growth by continents, subcontinents and countries which has occurred since the year 1900, as well as that which is predicted for the remainder of the present century. As shown in Figure 1, the greatest population increases are occurring in the world's least developed areas. It is in these very areas that a phenomenon known as 'the increased awareness of the have-nots' is occurring, as a result of which the people are demanding a greatly improved standard of living — one that is comparable, in fact, to that enjoyed in other parts of the world. Because of a consequent increase in the *per capita* demand for earth resources (as well as an exponential increase in the *total* population), the picture suggested in Figure 1 would look all the more like an inverse 'horn of plenty' if its X-axis were graduated in 'resource demand' units rather than in 'population' units. Clearly, then, the situation in which we find ourselves is one which calls on us to develop and manage our natural resources as intelligently as possible.

A first step in this direction is that of obtaining accurate inventories of these resources at frequent intervals. Several of the examples which follow have been selected to illustrate the extent to which the making of such inventories can be facilitated through the use of space photography.

Figure 2 is a space photograph of one of the earth's potentially important developing areas. Central Australia's characteristic topography appears in that photograph, as it was recorded on 27 August 1965, by the Gemini V astronauts from an altitude of 165 miles. According to Australian scientists, virtually all of the significant geologic, soil and vegetational features found in approximately 70 percent of the continent (i.e., in its arid regions) are represented in that photograph. Furthermore, highly analogous areas are known to cover large portions of Africa and South America. Therefore, we are justified in considering quite carefully both the possibilities and the limitations inherent in such space photography for the making of meaningful inventories of various kinds of natural resources. During the 100 years that have elapsed since scientists first viewed this area, successive generations of them have added to man's knowledge of it.

It may be easy merely to delineate natural resource boundaries on a space photograph, but can one analyse such a photograph fully enough to conclude something useful regarding the various kinds of natural resources that are within those boundaries? Alternately stated, can the interpreter of space photography make natural resource *identifications* or is he limited to making merely natural resource discriminations? We should find it instructive to attempt the resource identification task for the area shown in Figure 2, as described in the following paragraphs.

First, let us consider possibilities for the identification of geologic resources. The southern part of the MacDonnell Ranges (A in Figure 2) has steeply dipping parallel beds that the geologist would recognize as indicating the presence of folded sedimentary rocks varying in hardness and in susceptibility to erosion. The characteristics of the northern part of the range would suggest to the geologist that the rocks there are igneous or metamorphic. Evidence of faulting appears in the linear ridge that runs through the northern part of the range. The characteristics of the Waterhouse Range (B in the illustration) suggest sedimentary rocks that long ago were folded into an anticline or upfolded structure, and have since been eroded to varying degrees. Careful study of shadow detail in the vicinity of the circular structure known as Gosse's Bluff (C) reveals that it is a hollow outcropping of rocks that probably resulted from the impact of a large meteorite.

From even this crude interpretation of the photography, a mineralogical prospector would be able to deduce tha

Robert N. Colwell *is Professor of Forestry at the University of California, Berkeley, and Director of the California branch of the Earth Satellite Corporation.*

etected from space

by ROBERT N. COLWELL

me of the best prospects for metallic inerals are to be found along the iscernible fault lines in the MacDonnell anges. The petroleum geologist would e interested in the folded anticline of he Waterhouse Range. It is equally gnificant that the searchers for both netals and petroleum often can eliminate nearly 90 percent of the vast area shown n a small-scale photograph as being nworthy of detailed mineralogical or etroleum surveys. Important deposits f either kind are rarely found in areas hat photographically show little geologic vidence of their presence.

The space photograph of Figure 2 is also helpful in assessing the *soil* resources of the area. For example, there are three major reasons why it can be assumed that most of the central region (D) has deep alluvial soils: (1) because there are nearby mountain ranges from which alluvial deposits are likely to have come, (2) because the pattern of streams indicates that a considerable amount of outwashing activity has taken place even though the area now seems arid, and (3) because in the outwash plains geologic features have become so deeply buried, presumably by deposited soil, as to be indiscernible. In the top left portion of the photograph (E) the presence of sandy soil is suggested by the dunelike patterns. A dry lake bed (F) is likely to contain heavy clay soils of high salinity.

The photograph is of further usefulness in determining the *vegetational* resources of the area. Even though the photographic scale is small, several vegetational boundaries can be seen. One of considerable significance (H) shows two types of grass: Mitchell grass on the left and spinifex on the right. Areas of Mitchell grass are far better than other grassland areas for maintaining livestock. Moreover, they normally are indicative of the most fertile soils in an area, a point of great importance if the objective is to find new land to put to the plough.

Figure 1 — The greatest increase in 20th century consumers of natural resources has been and will continue to be in developing countries. Increase in per capita demand for natural resources is also expected to be greatest in the same countries during the remainder of this century.
(Source: Earth Resources Survey Program, NASA)

From high and low

In mapping vegetational boundaries the lack of fine detail in a photograph such as the Gemini one may actually be helpful. The fact is evident if one looks at the area marked G in the Gemini photograph and at the corresponding oblique aerial photograph at the bottom left in Figure 3. The boundary is between mulga (a type of acacia tree) and spinifex. In the Gemini photograph the boundary is clear; in the oblique photograph it is difficult to follow even though more detail is discernible there.

After the Gemini photo of Figure 2 had been taken, the author and personnel of the Commonwealth Scientific and Industrial Research Organization of Australia made a check of the ground shown in that photograph. We made the oblique aerial photographs that

appear in Figure 3. The check showed that the interpretations previously made from the Gemini photograph, as detailed above, were correct in all respects.

I have dwelt at length on this single photograph in order to suggest some of the tremendous possibilities for using space photography as an aid to the development and management of natural resources. Since the whole of an area as big as Australia can be depicted in a short time with a few photographs from a spacecraft, the possibilities of the technique are enormous, particularly for the vast areas of the world that are yet to be developed. Australia is a case in point. It seems evident that one of the best ways to produce suitable reconnaissance maps for the remainder of under developed Australia and for other under developed areas of the world would b through the use of space photography supplemented where necessary wit large-scale aerial photographs and wit field checks.

In order to achieve the most efficien management and utilization of his re

Figure 2 — An area west of Alice Springs in the Northern Territory of Australia, photographed from an altitude of 165 miles by the Gemini astronauts in August 1965. The letters in white indicate places pictured in oblique aerial photos in Figure 3.

urces, the wild-land manager must be e to collect and integrate information garding the physical and biological atures of his land. For example, he ust recognize important relationships tween land form, soil condition, mois- re regime and vegetation type so that can better formulate management ecisions that will assure a continuous flow of renewable resources without depleting those resources. That such relationships exist in at least one area (viz., central Australia) already has been illustrated by means of Figures 2 and 3. Perhaps Figure 4, dealing with an undeveloped area in the Sonora desert of North America, documents even more convincingly, and for yet another area, the existence of such relationships and the ease with which they can be inferred from a space photograph.

The top photo in Figure 4 is a 10-diameter enlargement of part of a space photo that was taken in March 1969 of an area southwest of Phoenix, Arizona, U.S.A. by the Apollo 9 astronauts from an altitude of approximately 120 statute

Figure 3 — Oblique aerial photos taken of selected features that can be readily discerned on the space photo, Figure 2. Annotations on Figure 2 indicate the camera station and camera orientation of each of the corresponding oblique photos above.

Some basic principles for resources assessment with space photography

As we have seen, the extraction of natural resource information from space photography is, at best, a difficult task. The task can be greatly facilitated, however, if care is taken to exploit the various principles that are listed and discussed in this section. The first four of these principles apply primarily to image acquisition and the remaining four to image analysis:

1. **Multiband** space photography often can yield more information about earth resources than is obtainable from space photography that is taken in only one wavelength band. This is consistent with the finding that each type of resource feature tends to reflect energy in distinctive amounts at specified wavelengths as a function of its atomic and molecular composition. It is the energy reflected from a feature to the camera that governs the tone with which that feature is rendered on the photograph. Hence, each type of feature tends to exhibit a unique 'tone signature' when it is photographed in the proper wavelength bands. The larger the number of bands used in obtaining the photography (through simultaneous use of several cameras) the more elements of the signature are decipherable and the more certain the identification of the feature becomes.

2. **Multidate** space photography likewise can yield more information about earth resource features than is obtainable from photography taken on only one date. This is consistent with the fact that most earth resource features are dynamic rather than static. Each type of earth resource feature tends to exhibit a unique temporal variation or 'signature' when photographed at the proper dates. The more of these specified dates on which the photography is obtained, the more elements of the temporal signature become decipherable and the more certain the identification of the feature becomes.

3. **Multistage** photography (e.g., small-scale space photography of the entire area, together with larger scale aerial photography of representative portions of the area) can yield more information about earth resource features than is obtainable from photography obtained from only one such stage. Typically the space photography is used to provide an accurate delineation of boundaries between earth resource features throughout the entire area. Then larger scale aerial photography which is flown of selected spots within the areas that have been delineated permits a detailed accurate identification of the types of earth resource features occurring on opposite sides of the boundary. Thus, in the multistage sampling process, discriminations are made on the space photography, but most of the identifications must be made on the aerial photography, supplemented as necessary with direct on-the-ground observations.

4. **Multi-enhanced** space photography usually yields more information about earth resource features than if only one enhancement were made. The term 'image enhancement' has become an increasingly popular label for a number of specialized techniques designed to help image analysts extract useful information from multiband, multidate, multistage images. The primary purpose of any form of image enhancement usually is twofold: (a) to increase the total amount of information that can be derived from the multiple images of a given area, and (b) to facilitate the information-extraction process. The enhancements are produced either optically or electronically through the use of various kinds of equipment specially designed for the purpose.

If one such machine is designed to produce optically combined composite images while another machine is designed to produce electronically combined images, it is quite probable that more information can be obtained about various earth resource features through the use of both types of equipment than if only one of them were used.

5. **Multipurpose** studies usually will be more useful than studies prepared for only one purpose. Even if there is only one manager who is nominally in charge of the resources in any given area, there may be many other individuals who, for one reason or another, are interested in having much the same information but perhaps in a different or augmented form.

Thus, for example, the logging superintendent of a given forested area may be content, at any given time, merely with information on the location of each individual 'high risk' tree. (A 'high risk' tree is one which, because of declining vigour, is highly susceptible to attack by various insects and fungi and which therefore should be removed promptly before it becomes infested and also serves as an infection centre for other trees.) Even though more information than this might be derivable from the photography, it might be superfluous and even distracting for his specific purpose. This is so because his management decision at the moment is simply that of making the dichotomous choice, tree-by-tree, of 'cut' or 'leave,' since his immediate management plan is merely one of: (a) cutting each 'high risk' tree promptly and (b) leaving undisturbed, until some future date, all trees which currently are healthy.

Other individuals, however, may need basically the same information, but for a somewhat different purpose, and therefore in a somewhat different form and context. One such individual may be a forest entomologist who needs information on the 'population dynamics' of insects and pathogens in a large area of which this management area is only a part. He may wish to know, above all, the rate at which an infestation is spreading in each portion of the forest. His desire for this information may prompt the making of certain additional analyses, such as (a) a comparative analysis of infestations, tree-by-tree, or stand-by-stand, as detected on photographs obtained on different dates, and (b) a site analysis of infestations on the basis of which he may find it possible to determine what combination of slope and aspect, or soil type and soil moisture conditions commonly are indicative of 'high risk' sites. Still other potential users of this information may be employed in a variety of industries including those concerned with the production of insecticides and fungicides, the transportation of logs, pulp and lumber, and the marketing of various wood products. When this variety of users is considered, several resource analyses may be made, each being prepared to separate specifications in terms of frequency, detail and accuracy of reporting. To the extent that such multipurpose surveys are successfully made, it is axiomatic that the information derived from the space photography will be more useful than if the information was derived for only one purpose.

6. **Multisource** studies, based on space photography, usually will be more useful than a study that is based on only one resource. Usually the manager of resources in a particular area, in seeking to manage each portion of the area as wisely as possible, needs information regarding each factor of the total resource complex (e.g., vegetation, soils, water, minerals and topography). Furthermore, he needs such information not only within any given portion of the overall area that he seeks to manage; he also needs such information on all other portions of the area, for it is the interrelationships of these factors, both within an area and between areas, that govern the best ultimate use of each portion of the area and of the area as a whole. It follows that only through the making of a multiresource analysis, for the entire area and for each portion of it, will the interpreter of space photography provide such a manager with the information that he truly needs.

7. **Multivariate** treatment of space photography usually yields more information than if only one treatment were given on the presumption that all factors contributing to identification of the resource complex exhibit a uniform variability. For example, the amount of second and third stage sampling (e.g., through the obtaining of large-scale photographs and ground observations, respectively) that should be used to facilitate the identification of any given type of resource feature will vary according to (a) the difficulty of identifying the feature on space photography, and (b) the significance of the feature in relation to the whole resource complex. The more consideration that is given to this concept, when deciding upon the amount of second and third stage sampling to be used, feature-by-feature, the more efficient the sampling design is likely to become.

8. **Multianalysis** of space photography (by several properly selected photo image analysts) usually yields more information about earth resource features than if the analysis were made by only one analyst. For example, if photo interpreters from a variety of earth resource disciplines (e.g. geology, soil science, vegetation analysis and geography) are used in a 'conference' system, as they jointly analyse earth resource features on space photography they can collectively derive more information than if only one of them attempted the task. The principle known as 'convergence of evidence' applies very well here, in that the quantity and accuracy of resource information will be increased when the input of several team members can be used, each of whom approaches the image analysis problem from his own field of greatest competence.

miles. The arrow drawn on this space photo indicates the point from which the oblique photo below it was taken (nearly simultaneously) from an altitude of 2 500 feet above the terrain. Quite sharp boundaries can be seen, both on this photo and on the space photo, between uplands (left side of oblique photo), semidesert shrublands containing alluvial materials (middle of oblique photo) and a mesquite forest type occupying the watercourse of the Gila River (right side of oblique photo). The whitish area in the upper right portion of the oblique photo is a salt flat containing sedimentary deposits that are high in sodium salts. Field checking of an 'ecological transect' extending from the ridge top on the left to the salt flat on the right has shown almost perfect conformity between conditions actually found on the ground and those which might have resulted from an academic prediction.

Cloud cover

There can be little doubt from a study of the area indicated by the arrow in the top photo of Figure 4 but what the succession of *land forms* associated with such an area can be readily discerned even on a space photograph. Then, by relying on the association which is known to exist between land forms and other resource characteristics, the land manager can provide himself with information regarding virtually all other attributes of the resource complex. With the aid of such information he will better be able to decide upon the best use for each portion of the area (e.g., livestock grazing; the production of irrigated crops, drought resistant crops and salt-tolerant crops; human occupation for residential, industrial or recreational purposes, etc.).

It is equally important to emphasize the limitations of space photographs and to consider ways in which they might be overcome or minimized.

Cloud cover, by obscuring the surface of the earth, can easily comprise the most serious limitation to resource assessment from space photography. The extent to which the earth's surface is obscured by clouds can best be appreciated on space photographs that have been taken at a great distance from the earth, as in Figure 5.

Figure 4 — (Above) The Sonora Desert in the southwestern United States photographed by the Apollo 9 astronauts from an altitude of 120 miles. (Below) An oblique aerial photo of one section of the space photo (circled).

A study recently was made of the frequency of cloud cover in the corn belt of the United States during a typical growing season. It was concluded that on only one satellite overflight in thirty would cloud-free conditions be encountered throughout a representative 1 000-square mile area. Additionally it was calculated that even if a photo mosaic for this area were to be constructed from the cloud-free portions of successive photo coverages, 12 passes ordinarily would be required before a cloud-free mosaic could be prepared.

Other limitations to the usefulness of space photography as an aid to the development and management of natural resources will be found to occur in those instances where all of the available photography was taken on only one date and using only one wavelength band of energy. The limited amount of spatial resolution provided by a space photograph, although of advantage in some cases, such as that described with reference to Figure 3g, usually constitutes a serious limitation unless photography of portions of the area also is obtained at larger scale from aircraft and supplemented still further by limited ground observations. These limitations, and possible remedies to them, are discussed on page 44.

Finally, there can be serious limitations imposed by (1) *economic factors*, including the high costs that are associated with procurement of photography from space, and (2) *political factors*, including the political complications that can arise from the fact that many countries automatically come under the surveillance of a space-borne camera. Both types of limitations are discussed in recent articles by Katz (1969)[1] and Cleaver (1968)[2]. Katz, who also is concerned with the technical feasibility of making resource inventories on space photography, concludes that "what we need from earth-resource surveys can be gained easier, better, sooner and cheaper using aircraft rather than spacecraft, and in a politically more palatable and manageable manner." Evidence presented would seem to justify an affirmative answer to this question if only technological factors are considered, but leaves the question unresolved with respect to 'political palatability.' Cleaver, in his article, comments at length on difficulties associated with the high costs of space programmes. He acknowledges that European governments, in seeking to develop a viable European Space Agency, must be selective and must choose those space projects which promise the best economic return.

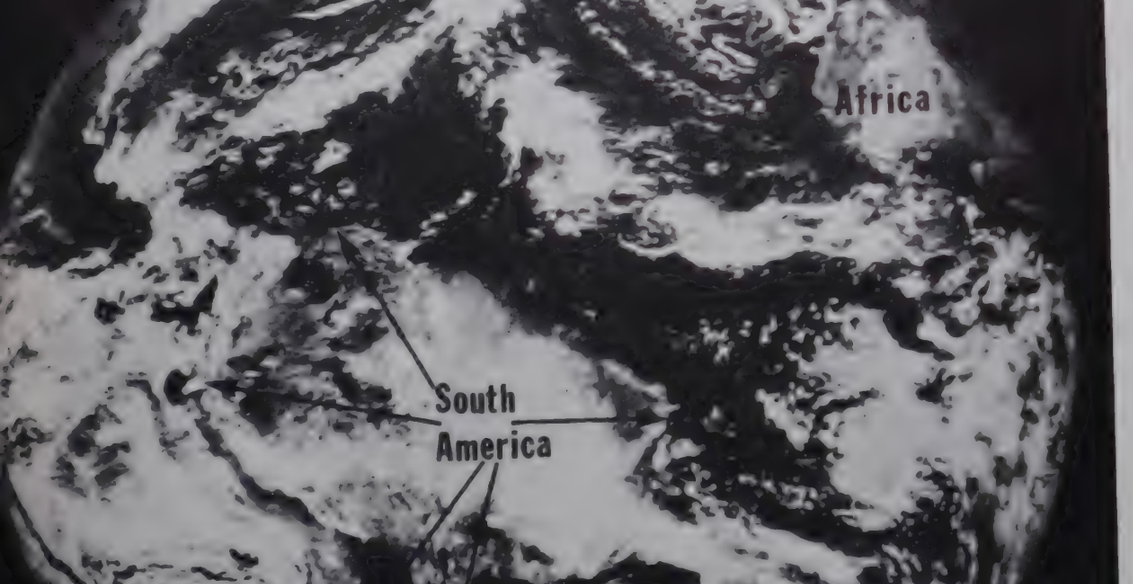


Figure 5 — The earth photographed from 22 300 miles away by a NASA satellite in geosynchronous orbit at the equator over Brazil. Some enthusiasts of space photography claim that the photograph shows all of North and South America, part of Africa and Europe and the southern part of the Greenland icecap. A more realistic appraisal, by way of acknowledging an important limitation of space photography for natural resource inventory, would draw attention to the heavy cloud cover. Although nearly one half of the earth is shown in this one photograph, clouds obscure almost all of the land masses.

Conflicting interests

But he also points out that "... the ultimate profitability of space ventures, with all their unpredictable potential for the long-term future, cannot be accurately assessed on a forecast limited to the next 5, or even 10 years. On such a basis it would have been difficult to justify the development, manufacture or operation of civil aircraft in the 1920s." He further observes, in speaking of the political complications: "Unless and until the whole western world is politically united, there are bound to be occasions when conflicting interests (even if still friendly and peaceful ones) arise between the democracies: especially when commercial competition, or questions of political and cultural influence are involved." ■

[1] *Katz, A.H. "Let Aircraft make Earth resource Surveys,"* Astronautics and Aeronautics *magazine, 10 p. Illus. June, 1969*

[2] *Cleaver, A.V. "The Crisis in European Space Affairs," in* Spaceflight, *Journal of the British Interplanetary Society, 10 (11) p. 370-371. 1968.*

Erosion, a social problem

Free grazing is its primary cause; the solution lies in concerted action by economists, foresters and managers

by ***PHILIP STEWART***

Free grazing has probably ruined more land than any other human activity. Today it is perhaps the most important single cause of deterioration in the rural environment of the third world. Over Africa, Asia and Latin America, it is the predominant land-use almost wherever conditions do not allow the development of settled agriculture or the persistence of rain forest. Reaching even into the great deserts, it affects above all lands which, because of their dry season, have a fragile biological equilibrium.

Whether it is practised by nomads or by settled peoples, as the main source of livelihood or as a supplement to agriculture, the fundamental characteristics of free grazing are freedom of movement over the available land and freedom from restriction on the number of animals. It is quite different in every essential from managed grazing, in which the biological potential of the land is carefully maintained and is the basis for the size of the herd. When it is said that pasture is a valid form of land-use for erosion control, it must always be understood that this means managed pasture.

Because there is no voluntary restriction, nothing prevents free grazing from growing in intensity until a stable minimum state is reached in which any further decrease in the mass of vegetation or increase in the mass of animals is 'corrected' by the starvation of part of the herd. Land in this state has a minimal productivity. The plants are mostly annuals which are able to complete their life cycle rapidly and perennials which can survive by their underground parts. Growth is not allowed to continue for long before the new shoots are eaten. Starting each year with a small 'capital' of vegetable matter, the 'interest' of new growth is small. The soil, compacted and partially bare, is poorly protected against erosion. Its capacity to absorb and retain rainwater is greatly reduced.

Philip Stewart *first studied Arabic and then became a forester. Since 1966 he has been a forestry adviser to various North African governments.*

The weakest element

Recent economic and technical developments have added to the pressure of grazing. Road and rail have brought new markets and new pastures within reach. Veterinary care, the boring of new wells, and the increased demand for livestock have pushed up the number of animals wherever the limiting factor was health, water or demand. It is to be noted that the latter includes not only consumer demand but also demand for herds as capital, for they are not only a means of production but also a stock of wealth. In some countries where private investment is restricted there has been a considerable flight of capital into this almost uncontrolled sector, so that many herdsmen have become the paid hands of absentee owners who control the animal market. Powerful interests have developed which can hinder the adoption and application of legislation to control grazing.

No amount of public or private investment can turn free grazing into a safe activity as long as its basis of freedom from restrictions is untouched. Misguided economic aid to the graziers, given without the introduction of restrictions, is simply an encouragement to overgrazing. Failure to act effectively is not justified by hoping that sooner or later the pastoral peoples will, of their own accord, come to manage their land scientifically. The needs are too urgent: the dangers are too great. One of the greatest dangers is deforestation.

Free grazing is by its very nature an invasive activity. Once it has reduced existing grazing lands to their stable minimum state, it can increase its production only by extending to new territory. Since farmers have a strong personal interest in defending their land, the encroachments are usually made on forests, where grazing rights often exist already and protection is inadequate.

Biologically, natural forest is at the opposite extreme from overgrazed land. The mass of vegetation tends toward the stable maximum and consists predominantly of large perennial plants reproducing themselves by seed. The soil, protected against erosion and explored in depth by tree roots, retains a maximum of rainwater for reevaporation. The weakest element in this powerful system is its regeneration. Prevention of this over a long period is enough to kill the forest. This is the effect produced when too many herbivores are introduced. They compact the soil, making it less receptive to seed, and they eat the seedlings, except such as are spiny or unpalatable. As the old

trees die they are replaced by grassy spaces which render the forest still more tempting. The process once started tends to escalate. Graziers have long known, moreover, that it can be hastened still further by deliberate burning. From the stable maximum to the stable minimum is but a few steps.

The consequences of turning large areas of forest into overgrazed pasture are very serious. The loss of wood production is only the least of the evils, for it may be compensated relatively soon by fast-growing plantations made elsewhere. The erosion of a great mass of soil, replaceable only by hundreds of years of biological activity, is much more alarming. Eroded land discharges destructive torrents in the rainy season and dust storms in the dry season. There are moreover climatic consequences, for much rain is lost to the sea or to underground deposits instead of being retained by the soil and evaporated. Ruined land is thus a source of hot, dry air, and so increases the aridity of conditions on neighbouring land.

A forest's agony

Ecologists agree that graziers have destroyed enormous areas of forest in historic times, though they differ in their estimates of the amount. The process continues almost unabated today, and it is possible to see land at all stages of degradation. Symptomatic of the disease is the great extent of so-called 'brushland' or 'scrub.' There are no doubt small areas over which shrubs and bushes are the climax vegetation, but by far the greater part of 'brushland' is simply forest in its dying agony. By giving a derogatory name to such land it is conveniently possible to forget that a biological disaster is being allowed to take place, and to avoid accepting the responsibility of providing a costly protection. 'Brushland' deserves to be recognized as forest and placed in the front line of defence.

It is hardly surprising that forest destruction continues today, for grazing rights are recognized in most forests in the third world and are exercised by people with a tradition of free grazing. Since they do not restrict the numbers and movements of their herds elsewhere, they cannot be expected to do so voluntarily in the forest. Any restriction must therefore be imposed by the forest authorities as a police action. To do this effectively would require a considerable and constant expenditure on fences and guardians. Governments have not in general been ready to pay the price, and so overgrazing today threatens the existence of enormous areas of forest. The policy is so absurd that it seems strange that it was ever expected to work. It is as though a man with a brush — a rather small brush — had been told to keep dry one room in a flooded house, while no one mended the burst pipe.

None of the techniques of forest maintenance and improvement can be applied where grazing is not controlled. Natural regeneration is too uncertain to permit planned felling. Artificial regeneration is too intensive for the forester to undertake without neglecting the rest of his forest. Thinning and pruning are a mockery where regeneration cannot be assured. Roads and firebreaks threaten to become highways for herdsmen. Even the abandonment of the natural forest for the making of new plantations is the pursuit of a mirage, for the plantations are almost certain to be on or next to someone's grazing lands and are likely to be invaded at an early date.

It is not a great exaggeration to say that forestry is impossible in such cir-

A HERD OF GOATS IN JORDAN GRAZING THE VEGETATION FROM
But there are people who depend upon those goa

mstances. The so-called forester is nply a policeman, spending his time the unproductive work of chasing ttle and goats and sheep, fighting a sing battle against an enemy whose se is beyond his reach. If he has ceived an expensive technical educa-on, he cannot use it. If he entered e forest service hoping to be anything her than a policeman he is likely to so demoralized that in the end he ithdraws into a comfortable office.

DY ERODED SLOPE
ving

The economics of forestry is com-etely distorted wherever free grazing igns. Expenditure is excessively high - though rarely high enough to guar-ntee the survival of the forest — but nsists almost entirely of maintenance costs and overheads; hardly any of the money swallowed up by the forest service represents productive investment. Revenues, on the other hand, are dismally low, for the simple reason that little is done to increase them. It is wrong to conclude that forestry is therefore a poor investment: one might as well decide that oil refining does not pay after examining a refinery built on an active volcano.

It is time to drop pretences and admit that foresters have been asked to do the impossible. Forests cannot be economically conserved as long as grazing is not managed on neighbouring lands. A forest is not a viable unit of management when it is part of a community's grazing lands. The solution cannot therefore be found by foresters acting alone: it requires an integrated team of specialists. But the initiative must come from foresters, for they are the losers in the present situation. FAO's Forestry Department could play a useful part by refusing to support forest development projects which are not linked to the necessary grazing management.

Independence of spirit

The decision to undertake an integrated programme of forestry and grazing control needs to be taken at a very high level of government, for potentially explosive human problems are involved. Many pastoral peoples have an independence of spirit born of their way of life: they are the unfettered masters of their land, noble eaters of protein, despisers of the back-bending work of cultivation. Even the agricultural peoples who practise free grazing are often fiercely attached to their freedom. If restrictions and control are not to seem like intolerable outside interference, the participation of first-class administrators and educators is necessary, backed fully by central government.

The territorial unit of management can hardly be other than the entire grazing lands of the communities that endanger the forest in question. If only part of these lands should be included, the remainder would probably become a refuge for surplus animals. If an arbitrary unit should be adopted, instead of one based on social groupings, it would be excessively difficult to develop the necessary sense of communal responsibility for the state of the land. It is not so much a question of developing a piece of land as of enabling the people who live on it to develop, for the use of land depends on the mind of the users.

Many resistances

It is, above all, in the planning stage that integrated teamwork is called for. The carrying capacity of the land, including the forest, must be calculated, and a schedule drawn up for the reduction of the number of animals and for the rotation of their movements. It is necessary to foresee the size and timing of the contribution that each sector can make to the development of the region, and the changing pattern of employment that will result. The forest service, having initially big demands to make on the other services and later considerable resources to offer, must be fully involved in the planning.

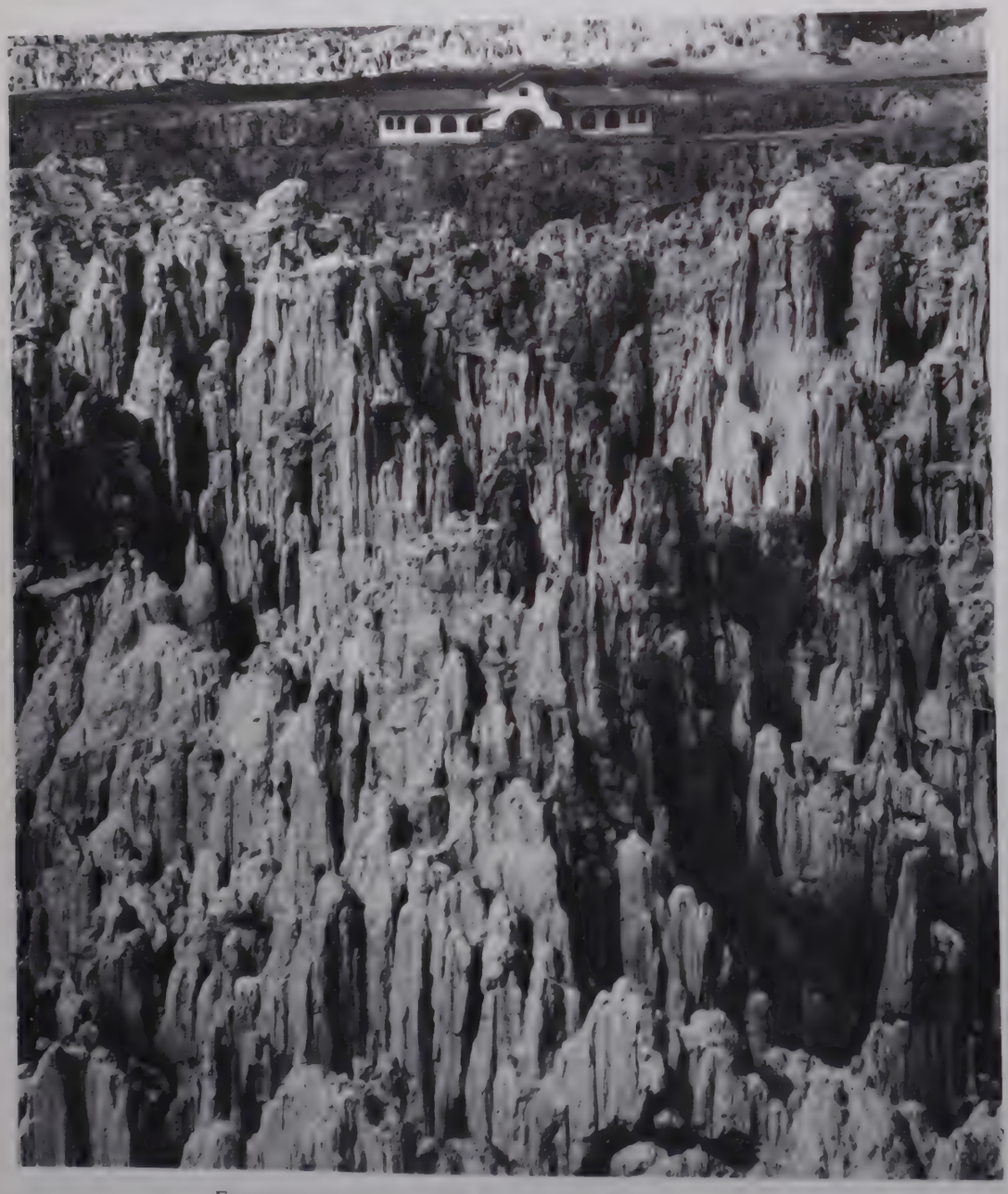
With the application of the plan, it will become increasingly possible for the various services to separate and specialize. Once forest grazing is controlled, the forester will be free to devote himself to silviculture and management and to employ a growing number of forest workers. In certain cases the forest may become the principal resource of the community, and grazing, having been managed, may slowly disappear, giving way to reforestation. This would be wholly desirable, for the long-term goal should be to reach a pattern of land-use close to the natural balance ruptured by centuries of misuse.

If what has been said above appears evident, it may seem astonishing that it has not long since been acted on. It is necessary to seek for the explanation of past inaction. If there are resistances to be overcome, in addition to the obvious reluctance of the graziers to abandon their traditional way of life, they must first be identified.

Foresters have known for centuries that overgrazing means the death of a forest. They have known for decades that they cannot effectively prevent overgrazing in countries with a tradition of free grazing. Yet even they may have resisted the idea of integrated action.

Many forest administrations have, for various reasons, a tradition of proud isolation — sometimes almost the exclusiveness of a secret society. Foresters may often have preferred to remain besieged by goats rather than venture out from the safety of the woods in search of allies.

As for those who sought early reperts, has not yet changed the balance of forces. There is, however, reason to fear that future demands for action will not be swiftly met. The informed public, including politicians, civil servants, economists and journalists, lives mostly in big cities. This is paradoxically even more true in the third world than in the industrialized countries. Urban problems therefore tend to receive a disproportionate amount of attention. Rural problems are too often seen with a townsman's bias. Overgrazing and deforestation do not affect cities as do urban pollution or the shortage of land for recreation. Indeed their effects are hardly visible to the untrained eye. There is therefore a great danger that their seriousness will not be appreciated.



EXTREME EROSION IN THE CORDILLERA RÉAL OF BOLIVIA
Underneath a forest floor

fuge in a city office, they cannot be expected to initiate integrated action in the field.

Since those responsible for forests have not called insistently for grazing management, governments can hardly be said to have resisted them. The arrival on the scene of other advocates, such as ecologists and range management ex-

There may be a deeper source of resistance, even harder to overcome. Man evolved in a grassland environment; according to recent studies, our ancestors lived for millions of years in savanna, steppe or prairie, alongside the herbivores which they hunted. *Homo sapiens* may belong instinctively to grasslands, and may have an inborn lack of attachment to forests, if not a positive repulsion toward them. He may be a deforesting species, not merely by economic compulsion or ecological ignorance, but by his very nature.

An old-age romantic figure

Such an hypothesis, like others relating to human instinct, would be extremely difficult to test. Many signs, however, point to its validity. Man's most consciously made landscapes — his parks and gardens — consist usually of grassy spaces in which trees stand isolated or in small groups just as they do in natural grassland. In the landscapes of folklore lawns, meadows, glades and pastures are places of peace and joy, while forests are the fearful home of brigands, witches, demons and monsters. Deforestation has proceeded unnoticed down the ages, while the recent limited efforts to reforest have often met with irrational opposition.

Pastoral man comes closer than any other major group to living what seems to be mankind's natural way of life. The shepherd is an age-old romantic figure, honoured by several great religions, inspirer of poets, painters and musicians, symbol of loving care and innocent happiness. Graziers may enjoy a kind of complicity from the public in their action on the land. In their conflicts with other land-users they may benefit from the involuntary connivance of the authorities. Foresters may be battling against inner forces inherited from the Pliocene.

It is no cause for pessimism to suppose that man is instinctively on the side of the deforester. On the contrary, it is by learning the secret of the enemy's strength that it becomes possible to defeat him. Man has had to fight against his own nature for many of his achievements. Such a battle may have to be won for forest conservation. ■

The economics of wildlife

Marginal land often yields profits when left alone

by MARCUS LINEAR

The preservation of wild game and its habitat is today a widely agreed upon and supported objective. However, growing pressures from increasing human populations and the consequent greater need for agricultural land tend to reduce the areas of wild land. Since much of this land is marginal from an agricultural or pastoral point of view, it is, once taken over for agricultural purposes, often degraded as a result of decreasingly productive agricultural and pastoral practices until, when it is once again abandoned, its wildlife has largely been exterminated and its natural vegetation disturbed, if not completely destroyed.

Since the developing countries whose good fortune it is to possess the last large-scale stocks of wild game are invariably in need of the most efficient use of their natural heritage in economic and social terms, the conflicting pressures of human needs on reserved land imply the need for the maximum justification of such reserves. Thus the potential product of these lands, both economic and social, must be evident and proven in order to resist competing demands from other forms of land-use.

In resisting pressures from those who tend to see all marginal land as potential beef-production areas, for example, one of the strongest arguments the conservationist can employ is the production of economically desirable quantities of game meat. It has, in fact, been established that on certain marginal land wild game has a meat-production capacity considerably above that of domestic cattle. The labour-employment potential which farming such areas can create could often more profitably be replaced by the development of a tourist industry with all its ancillary activities. Any number of minor rural industries based on the utilization of animal by-products can equally well be developed in a production of game meat as in a production of domestic cattle.

There is no 'status quo'

Conservationist thinking has developed in very recent years beyond the now generally popular idea of integral protection of wild animals in reserves and national parks. In studying the various and often unexpected problems which have followed on (or perhaps have been caused by) the application of this policy, biologists and ecologists recognize that nature is not a static, passive quality. There is rarely, in the long-term, a 'status quo'; rather the life forms of the natural environment are in a dynamic equilibrium, in continual movement, often as gradual as the coming and going of the ice ages, allowing for growth, development and retrogression. The main criticism which can be levelled at the integral reserve concept is that it is an attempt to freeze in time what is only one moment or stage of a dynamic, living, changing process.

Since the area of land which we can afford to set aside for nature reserves is limited, ecological influences on animal populations and their distribution are distorted. Natural fluctuations in animal numbers cannot be absorbed in a limited habitat. For example, the danger of destruction of the habitat by population explosions within the reserves (often a result of the imbalance produced by restraining man from his traditional hunting activities) cannot be prevented by the overspill or dispersion of the surplus population into the neighbouring areas, which would occur in a completely natural state. The human need for farm activities, which are pressing ever more closely upon the borders of reserved areas, must take priority over the needs for unlimited space of uncontrolled game herds, and damage to crops and to domestic herds must be kept within tolerable limits.

The control measures which can be, and in a few cases are being applied, vary with the size and urgency of the problem. The well-known elephant cropping scheme in Kenya, and the hippopotamus cropping in Uganda are examples of extreme measures to deal with dramatic problems. The shooting of thousands of elephants to avoid the destruction of the whole habitat by a too great concentration of these animals was

---

arcus Linear is a British freelance writer no has lived and travelled extensively in st Africa.

the solution to an avoidable problem. Ecological science has now progressed to a point where it can anticipate such pressures, and can propose the application of suitable measures to prevent such an extreme build-up.

The creation of control zones around the integral reserves, where excess game populations can be reduced by hunting, is a very desirable measure in most cases, and is being attempted, if all too slowly, in a few of the countries which are aware of this problem. However, a major difficulty which the developing countries have to face, in attempting to save what is left of their wildlife, is the cost of applying the necessary controls. 'Controlled hunting' sounds very well in theory, but in practice this control must be supervised by specialists — wildlife experts, veterinarians and biologists — backed by the whole infrastructure of an efficient, properly equipped game department. These specialists with their necessary equipment are expensive people.

Expensive measures

Without them any talk of controlled hunting is largely theoretical, since the basic facts on which control can be based — recurrent game censuses, conservation transects for surveys of habitat conditions and trends, assessment of seasonal meteorological influences, study of the incidence and influence of disease — as well as the application of control measures and the enforcement of regulations, cannot be left to the goodwill of the hunter supervised by the often too scarce and overextended local police force. Similarly, at the other extreme, in situations where game is in danger of extinction and measures are promulgated to ban all forms of hunting, these also require the expensive enforcement services and specialist advisers.

It seems desirable, therefore, that every attempt should be made to improve the economics of conservation and control by exploiting the commercial potential of wildlife and game reserves as intensively as possible with a view to achieving an integrated, auto-financing operation wherever possible. In any case, the land-use requirements of most developing countries necessitate the maximum utilization of all their resources, and few can yet afford the luxury of reserving large blocks of land simply for animals to be looked at. It is of interest to note, on this point, that two FAO experts working for the government of Botswana, created and developed 17 parks and increased the country's income from game from $200 000 to $3 500 000 per year in three years.

Some considerable advantages of game meat production as against cattle can be found in the factor of immunity to disease. Wild animals are in general resistant to several diseases which are either fatal to, or drastically reduce the production of domestic cattle. A notable example is trypanosomiasis, the nagana disease spread by the tsetse fly, to which most productive strains of domestic animals are extremely susceptible, while wild animals continue to live in tsetse-infested areas.

Great efforts and large sums of money spent in attempts to eradicate tsetse by killing off all wild animals have been found to be abortive and even self-defeating. While it is all too possible to shoot out the more visible larger diurnal mammals, it is in reality impossible to kill off the smaller mammals, many nocturnal animals, and birds. And the tsetse will quite as happily follow a troop of baboons or small antelopes or a flock of guinea fowl as a herd of buffalo or antelope.

On the other hand, clearing bush to destroy the habitat of both the tsetse and its wild animal hosts is a drastic and expensive measure, which is rarely justified economically on marginal land, and can result in an ecologically disastrous destruction of the range, in increases in the populations of less desirable forms of wildlife, and when the effects of overgrazing by domestic cattle are added, in the rapid development of erosion and the production of desert

ZEBRA ON THE
One way to preserve al

nditions. Furthermore, the latest meth-
ls of tsetse eradication by biological
r genetic means, while being apparently
ffective, and in some areas economically
easible, are by no means permanent,
nd where the tsetse habitat persists in-
act, there is always the danger of re-
festation.

them, as, for example, in the case of tsetse.

Any proposals for the extension of cattle raising in areas with large game populations should be carefully examined in relation to the various studies which have been made in different parts of the world of the meat production

OF KENYA
ake better use of it

Another factor which influences the policy of limited integral reserves is the danger of whole animal populations being wiped out by imported diseases, some of which (rinderpest is one example) can be transmitted from domestic herds in neighbouring areas. The herds of wild game living in reserves surrounded by farming land are virtually irreplaceable, in practical terms, and are in need of continual protection against the danger of extermination by imported diseases. The inverse argument equally applies: game reserves must not become a source of infection of domestic herds in areas surrounding potential on a sustained yield basis of wild animals. When the difficulties of cropping and marketing are weighed against the capital costs of stocking, bush-clearing, construction of water-points and range improvement, as well as the high costs of labour and protection measures such as dipping and vaccination, game cropping may well offer many advantages.

Marketing difficulties for game meat certainly exist. But they also exist in any expansion of domestic cattle raising. Sanitary regulations often present difficulties for the sale of game meat through normal channels. Animals shot in the field cannot so easily be treated according to standard abattoir procedures — for instance, regarding the bleeding and rapid chilling of the carcass — and it may be desirable, in some situations, to set up a separate game marketing system, with special retail outlets. In fact, in the United Kingdom, France, the Federal Republic of Germany and many other countries, this exists. Mobile abattoirs are practical where a small production and marketing operation is envisaged, while bigger scale operations necessitate capture of the desired species and live transport to a central abattoir for slaughter and processing.

Illegal hunting

Field-dried and pasteurized game meat offers considerable advantages from the storage, transport and sanitary points of view, in regions where the consumer accepts meat thus processed. In some cases, however, as in the Transvaal, the sale of dried meat, biltong, is in theory prohibited, as this is the preferred processing method of the poacher, and the authorities there feel that to allow sales of legally produced biltong would leave the door open for the illegal hunters whom they are trying to bring under control.

It is interesting to note that most of the illegal hunters who have been decimating the game herds of Botswana in recent years come from South Africa, and that the biltong to be found in regions bordering on South Africa, where it is sold however illegally for prices ranging from 20 cents to over one rand per pound, originates for the most part in Botswana.

In many Muslim countries where pork is taboo, warthog and wild boar are hunted and killed as a threat to crops but the meat is wasted. In Senegal a beat is organized each year and in some years as many as a thousand pigs have been reported shot but the meat is left to rot. In Somalia, another Mohammedan country, wild boar are destroyed mainly by trapping, for the same reasons, and their carcasses are hung on stakes " pour encourager les autres. "

Another example of this kind of waste in Somalia is indicated by the fact that in some years the export of duiker an-

telope skins has reached the figure of 400 000. Game meat is not, however, much appreciated in that country, where a major resource is cattle, and which has difficulties in disposing of domestically raised meat, so that apart from a very few dried duiker carcasses offered for sale around the village markets, the majority of this meat is wasted. As problem to farmers, they were shot and the meat wasted on a large scale.

Marketing difficulties certainly exist, but so do the markets, and overcoming the one to reach the other should be the primary aim of all concerned with the exploitation and development of the potentially rich resource which game represents.

POACHERS IN BOTSWANA LOADING A GEMSBOK INTO A TRUCK
Part of the economy

this can be assessed at as much as a million kilos, the size of the problem becomes striking.

New Zealand, a country not famous for its wildlife, earned $NZ2.7 million in 1968 from export of venison to the Federal Republic of Germany. This meat came from the controlled hunting of 75 000 red deer. New Zealand started utilizing its red deer herds as export money earners only about ten years ago. Up to then, because deer constituted a

None of the ideas expounded here are new; during the last ten years various game-utilization and sustained-yield cropping schemes have been more or less successfully set up. The Luangwa Valley in Zambia has been equipped with a highly efficient abattoir, and refrigerated trucks carry fresh meat to the main centres of population. The governments of Kenya and Uganda have successfully carried out the elephant and hippopotamus cropping schemes mentioned earlier which also involved domestic utilization of the meat.

At least one meat importing firm, a large Italian company, is now engaged in talks with the Tanzanian government about the creation of a joint company for the commercial utilization of game meat. The primary objective would be to supply game meat to a Tanzanian market. Expansion of this to include export of game meat to Europe would depend upon the success of this domestic venture first and upon the kind of processing plant that would be set up. European health regulations regarding imported meat would be a key factor in the processing of meat for export. And research into market acceptability is, of course, a fundamental prerequisite.

Protectionists v. scientists

During the past ten years the point of view of the wildlife protectionists has been made very strongly and often in the public information media. Many wildlife specialists have become discouraged by the apparent futility of putting forth scientific positions in the face of frequently emotional public responses to the more easily understood sentiments of the protectionists.

When the colonialist powers finally withdrew to their own homelands, many of the African settlers and expatriates said, frequently and openly, "This is the end of wild game in Africa." Fortunately, and by and large, these gloomy predictions have been proved wrong by subsequent events, but the result of this kind of reactionary or colonialist thinking is that, even today, none but the most enlightened and self-assured governments of developing countries dare to risk an unfavourable national image in this respect. Thus, proposals for game utilization and cropping can very easily be nullified by the protectionists' criticism that cropping controlled quantities of wild herds will raise the spectre of a country bent on the mass slaughter and extermination of its wildlife.

Many protectionists, say the scientists, do not include man in nature. Scientists quote instead the French biologist François Bourlière who said: "It is not against man, but with him, and for him that nature will be safeguarded." ■

2.09 p.m. Greenwich Mean Time:

Mrs. Tojo is enjoying a bowl of rice in Osaka.

In Georgia Jim Malloy is plucking peaches for dispatch to many countries.

A Red Cross helicopter is carrying synthetic blood plasma to the scene of an accident on the autobahn near Cologne.

How are these events related?

In each case – in a different place and for a different reason – BASF is involved.
The individuals may not be aware of it. They may never have heard of us. But we work for them.

Mrs. Tojo owes her daily rice to fertilizers produced not only in Japan but everywhere in the world by techniques based on processes developed by BASF.

We place a protective packaging material at the disposal of Jim Malloy for his perishable fruits. It is our expanded plastic ®Styropor produced directly in the U.S.A.

The accident victim on the autobahn is being treated with synthetic blood plasma made from products manufactured in our plant in Ludwigshafen.

Our scientists and technicians work in many countries throughout the world. Our plants are located in six European countries, in the U.S.A., Central and South America, in Asia and Australia. We maintain trade relations with more than 130 countries, and the worldwide network of our subsidiaries serves our customers on all continents.

BASF – A world enterprise in chemicals.

BASF

There are many ways to get more food from earth. The simplest is to provide the crops with the right nutrients without useless waste.

To feed the crops is easy: there are lots of good fertilizer brands to chose from. To avoid waste is another pair of boots. Only a complex granular fertilizer can prevent this. In a Seifafert, for instance, the plant nutrients linked in a definite chemical structure by a modern synthesis give to the crops the right amount of food at the right moment. The granular shape of Seifaferts allows an easy and even broadcasting and, at the same time, avoids their being swept away by the wind or washed away by the rain. More concentrated, they are less bulky: this means savings in transport, storing and broadcasting. Even the package can be peculiar: you may get Seifafert granules packed in heavy duty waterproof vinyl bags so that, they can be safely stored outdoors.

SEIFA

Piazza Duca d'Aosta, 4 - Milano

SEIFAFERT is the registered trademark for Seifa complex fertilizers. Further to these, Seifa markets all types of straight fertilizers.

PQ 00769-D

BOOKS

Diagnosis and cure

The World Food Problem — A Guardedly Optimistic View by Willard W. Cochrane and Thomas Y. Crowell. New York, 1969, 331 p., $7.95.

This book attempts a selective synthesis of recent studies and ideas " . . . to build an understanding of the world food problem and its solution . . . ." In the main, the author is successful in his objectives. His conclusions have a solidity and balance that are sadly lacking in many recent books on the world food problem.

Dr. Cochrane, now Dean of the Office of International Programmes, University of Minnesota, draws heavily on various studies by the U.S. Department of Agriculture, where he served as Director of Agricultural Economics under Secretary Freeman. The various studies and ideas have been strained through his own experience and well-known capabilities for critical analysis.

The first part of his book formulates a diagnosis of the world food problem. He points out that despite the dire predictions uttered daily, world food production has increased somewhat faster than world population growth in the 1950s and 1960s. He believes that the technology and resources are available to keep future rates of increase in food production ahead of population growth, but that the food problem is real and urgent. He identifies three principal elements of the world food problem:

— some 2 thousand million people in the world live in countries where most of the inhabitants suffer from malnutrition and many are hungry;

— the total demand for food has been increasing faster than food supplies; this is due to the combination of growth in population and the rise in income which increases per capita food demand;

— food shortages and rising food prices in developing countries give rise to dangerous social and political unrest.

The second part of the book analyses how the world food problem should be dealt with. It emphasizes the size and complexity of the problem, formulates a five-pronged multidisciplinary approach and provides a detailed analysis of the scope and implications of each of the components of the five-pronged approach. Birth control is seen as necessary to moderate the rates of agricultural and economic growth which must be achieved. Food aid can buy time and ward off starvation. Economic and technical assistance from developed countries can speed up the development process. Integrated programmes of agricultural development must be designed by countries to speed up the shift from traditional to modern, scientific agriculture and thereby raise agricultural growth rates to 4 percent or more per year. Finally, this can be successfully accomplished only if the overall economy is developing in a comparable fashion. In his analysis of the components of these approaches I found his discussions of the progress-oriented governments in Chapter 10 and the relationships among food, agriculture and economic development in Chapter 11 particularly penetrating.

Increased social discipline

In the final part of the book, Cochrane presents his recommendations for developed and developing countries. He places special emphasis on international marketing arrangements and the 'reformation of development strategies.' Developed countries' assistance in these areas, in his view, should be provided through the United Nations and specialized agencies, and the United Nations should exercise more creative leadership in this respect. Cochrane feels that rapid development will require an increase in social discipline at all levels in the developing countries. Organizational aspects also will be crucial. Increased flow of investment capital in the developing world, in his view, must come mainly from the savings and revenues derived from the populations themselves and more investment from private foreign business firms.

Contributions of the book lie in the quality of his analysis and the balance in his approach rather than in the development of new ideas.

K.L. Bachman
FAO

First survey of subsistence agriculture

Subsistence Agriculture and Economic Development, edited by Clifton R. Wharton, Jr. Aldine Publishing Company, Chicago, 1969, 481 p. $12.50.

Subsistence farmers, producing mainly for consumption in their own households, are the most numerous class of mankind. Yet this important book is the first to be devoted to a comprehensive survey of subsistence agriculture.

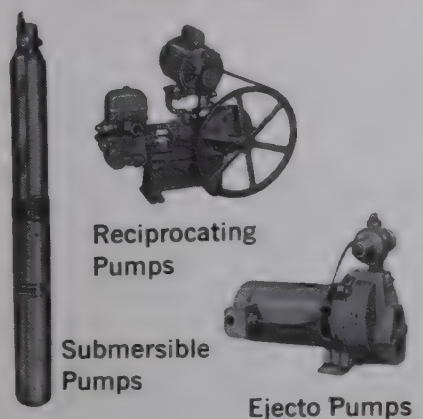
It is an outstanding example of the value of multidisciplinary discussion, stemming from a seminar held in Honolulu in 1965 by the Agricultural Development Council, Inc. and the East-West Center of the University of Hawaii, attended by 40 distinguished social scientists from 11 different countries and almost as many different disciplines. The book succeeds in capturing the lively and controversial flavour of the seminar.

How far is it possible to generalize about subsistence agriculture and the world's subsistence farmers? The several contributors who stress the need for specific analyses of each particular society or economy include Raymond Firth, whose examination of the interaction between social and economic factors in peasant societies provides economists with a good illustration of the potential contribution of the development-minded social anthropologist. Among those who believe that generalizations can be made, Everett M. Rogers attempts to synthesize what is known about the motivations, values and attitudes of subsistence farmers, and suggests that a " subculture of peasantry " can be defined — this is disputed in a spirited comment by Gelia T. Castillo. Similarly, H. Myint finds the traditional village economies of Europe, dealt with at length by Nicholas Georgescu-Roegen, of little relevance to the developing countries today.

Amid the general neglect of subsistence agriculture in the past, the one aspect that has attracted a good deal of attention is the economic behaviour of subsistence farmers — whether it is 'rational' or not, and whether it is determined primarily by economic or none-

Myers

Highest Quality Since 1870



Reciprocating Pumps

Submersible Pumps

Ejecto Pumps

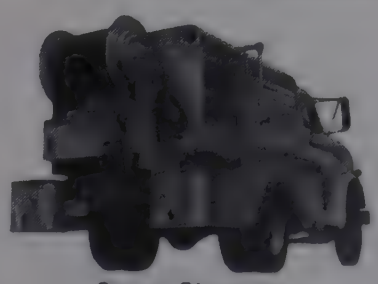
Tank Mounted Water Systems

Reciprocating and Centrifugal Industrial Pumps

Agricultural and Industrial Power Sprayers

Domestic and Commercial Water Conditioners

High Pressure Hydraulic Cleaning Equipment



Sewer Cleaners

INTERNATIONAL DEPARTMENT

THE F. E. MYERS & BRO. CO. · McNEIL CORPORATION

economic factors. Here the contributors represent a wide diversity of views. The book also includes an elaborate set of microeconomic models by Chihiro Nakajima — which, however, neither Raj Krishna nor Anthony M. Tang finds very enlightening. John W. Mellor looks in detail into the values, objectives and decision-making of subsistence farmers and, according to Carl K. Eicher, 'counterbalances' almost all of his propositions, thus implying that generalizations about the microeconomics of subsistence farmers are not possible at present. In one of the best of the case studies, Jere R. Behrman uses a Nerlovian model to provide striking evidence of supply response to market forces in Thailand, not only for three commercial crops (cassava, maize and kenaf) but also for the primary subsistence crop (rice).

On the macroeconomic level, three well-known sets of two-sector models are presented: those of E.K. Fisk and R.T. Shand for the development of a primitive economy; William H. Nicholl's analysis of the role of agricultural surplus under various conditions of population pressure and land tenure; and Dale W. Jorgenson's 'neoclassical' model. Among the commentators, William O. Jones pertinently criticizes the "phisiocratic willingness of many two-sector modelers to divide all human behaviour into farming and everything else — usually designated as leisure — and to regard only the first as economic."

Concerning the policy measures for developing subsistence agriculture the book is less successful. There is an interesting discussion of the approaches advocated by Theodore W. Schultz in his *Transforming traditional agriculture*. There are four useful case studies of specific programmes of planned agricultural development. But this part of the book suffers by not emerging organically enough from the preceding chapters.

Some of the commentators in the earlier parts in fact complain that the papers they are discussing do not adequately bring out the policy implications. For, in spite of the remaining controversy, there are some areas of general agreement where policy recommendations could already usefully be sought. Perhaps the seminar of social scientists should now be followed by a meeting of administrators to draw policy conclusions.

But, even though another book may still be needed, the present one succeeds admirably in assessing the current state of knowledge and in proposing a research agenda on the outstanding issues. This is done in a valuable final chapter by the editor, Clifton R. Wharton, Jr. His proposals are far too wide-ranging for summary here, but in view of the too frequent emphasis on the negative features of subsistence agriculture it is refreshing to be able to quote his plea for research on "the positive aspects of the motivational, attitudinal and goals structure of peasant and subsistence farmers — those elements that could be successfully utilized and exploited for the more rapid development of subsistence agriculture."

Almost the only aspects of subsistence agriculture not covered in any detail in this book are the macroeconomic magnitudes — how many subsistence farmers are there, and how much of agricultural production is for subsistence? These get only a brief mention in the editor's introduction. They happen to be an area that has much preoccupied the reviewer, but they are also of considerable importance in planning and policy-making. Knowledge of the share of subsistence in total production and consumption is required for supply and demand projections. The growing importance of employment problems also makes it essential to know how the available market, and hence income-earning and employment opportunities, are distributed among the farming population.

By-passed by progress

One of the most basic elements in economic development is that agriculture, which began as a subsistence-oriented activity, becomes more and more commercially oriented, as farmers not only sell more of their output but also use more purchased inputs. However, it seems likely, as one of the consequences of rapid population growth, that a great number of the world's subsistence farmers will be largely by-passed by economic development for a long while to come. Many of them will have little opportunity to participate in the devel-

pment of society unless special welfare measures are taken in their favour. For the planning of such measures, as well as more general policies for the promotion of commercial agriculture, this book provides an invaluable basis that has not been available before.

K.C. Abercrombie
FAO

Nineteenth century miracle

Recent Trends in the Cooperative Movement in India, by R.B. Tyagi. Asia Publishing House, London, 1968, 476 p. £6.

Cooperation may be described as 'one of the economic miracles' of the nineteenth century. Cooperation as a form of economic organization first originated in England and later spread to other countries and emerged as a worldwide dynamic movement.

In India the cooperative movement was officially launched in 1904 by the state itself. Since 1951 when the era of development by planning was ushered in by the national Government, the state is playing a positive role in developing the cooperative movement as a ' part of the scheme of planned development. '

The recent period has witnessed vast and quick changes and new developments. In the field of agricultural credit, the orthodox pattern was given up; primary societies are reorganized into larger viable service cooperatives; the old crude credit policy has been replaced by a scientific 'crop loan' system; the superstructure of cooperative central and apex banks has been reorganized and streamlined and land development banking has been developed in all states.

Adopting an integrated approach, concerted efforts are made to link credit with production on the one hand, with processing and marketing on the other hand. The movement has diversified and various kinds of cooperatives have expanded vastly. They include marketing and processing cooperatives and large-scale sugar mills, irrigation societies, farming societies and milk supply societies and unions, consumers' cooperatives including supermarkets, and industrial and housing cooperatives.

Various types of special ones have also been organized to help weaker sections. Facilities for training of coopera-

New Praeger Books on Development

THE CRISIS OF DEVELOPMENT

By Lester B. Pearson

A wide range of problems and solutions in the area of international development are dealt with here by Canada's former Prime Minister—and the Chairman of the Commission that produced the headline-making *Partners in Development*. The author discusses the meaning of development, its historical context, the current economic aid situation, and its prospects for the future. LC 76-115105 $4.95

SEEDS OF CHANGE

The Green Revolution and Development in the 1970's

By Lester R. Brown
Foreword by Eugene R. Black

The first full report of the cultivation of new strains of "miracle" rice and wheat. "Everyone concerned with development should read Lester Brown's admirable study, which gives the best account available of the full scale of the Green Revolution."—Barbara Ward. Published for the Overseas Development Council. LC 77-109015
Cloth $6.95 Paper $2.50

Praeger Special Studies

CO-OPERATIVES IN ASIA. By Mohinder Singh. A comparative study of co-operative institutions in Asia; together with detailed case studies that illustrate the problems of management, the role of government support, and the importance of local decision-making. 508 pp. LC 69-19344 $20.00

COMMUNIST CHINA'S AGRICULTURE: Its Development and Future Potential. By Owen L. Dawson. A study of the current state of mainland China's agriculture, and its prospects for growth in the next decade.
346 pp. LC 77-94249 $15.00

FARM INFORMATION FOR MODERNIZING AGRICULTURE: The Taiwan System. By Herbert F. Lionberger and H. C. Chang. The authors analyze the organization and operation of Taiwan's entire agricultural research-extension agency system, including its mass media extensions.
454 pp. LC 77-119028 $21.50

THE MOSHAV IN ISRAEL: A Case Study for Institution-Building for Agricultural Development. By Maxwell I. Klayman. The first in-depth analysis of the development and success of the *moshav* and its potentialities as a model for agricultural settlements in Africa, Asia, and Latin America.
392 pp. LC 69-19334 $18.50

Bench Mark Series on Latin American Agricultural Development

These analyses of the agricultural sector within the framework of the total economy of six Latin American countries are based on research sponsored by the Ford Foundation. Each book has a Foreword by Lowell S. Hardin, Program Officer, Agriculture in Latin America, The Ford Foundation.

THE AGRICULTURAL DEVELOPMENT OF PERU. By A. J. Coutu and Richard A. King.
214 pp. LC 68-55000 $12.50

THE AGRICULTURAL DEVELOPMENT OF BRAZIL. By G. Edward Schuh, in collaboration with Eliseu Roberto Alves.
400 pp. LC 69-19343 $18.50

THE AGRICULTURAL DEVELOPMENT OF MEXICO: Its Structure and Growth Since 1950. By Eduardo L. Venezian and William K. Gamble.
308 pp. LC 68-55020 $15.00

THE AGRICULTURAL DEVELOPMENT OF ARGENTINA. By Darrell F. Fienup, Russell H. Brannon, and Frank A. Fender.
476 pp. LC 69-19025 $17.50

THE AGRICULTURAL DEVELOPMENT OF URUGUAY: Problems of Government Policy. By Russell H. Brannon.
406 pp. LC 68-28469 $15.00

THE AGRICULTURAL DEVELOPMENT OF VENEZUELA. By Louis E. Heaton.
350 pp. LC 68-55006 $15.00

PRAEGER PUBLISHERS A complete catalog is available on request.
111 Fourth Avenue, New York, N.Y. 10003

Representatives: CANADA: Burns & MacEachern Ltd., 62 Railside Road, Don Mills, Ontario. GREAT BRITAIN, IRELAND, AND COMMONWEALTH: Pall Mall Press Ltd., 5 Cromwell Place, London S.W. 7, England. OTHER AREAS: Feffer and Simons, Inc., 31 Union Square W. New York, N.Y. 10003.

Photo: ONF/Gar Lunney

If Your Country Needs Water

- FOR AGRICULTURE
- FOR POWER GENERATION
- FOR MUNICIPAL USE
- FOR FORESTRY

Get the full facts on
CLOUD SEEDING FOR WATER PRODUCTION
WITH WECOA'S EXCLUSIVE NEW
WEATHERCORD®

A revolutionary new cloud seeding technique which can deliver fresh water, on site, for less than 1/10 of one cent per thousand gallons ! WEATHERCORD was first unveiled at the Water for Peace Conference in 1967. It has been thoroughly proven in North America and the Middle East. For the past two years it has been filling reservoirs to overflowing for the Imperial Government of Iran. WEATHERCORD can work successfully in arid regions.

Write for brochure and full story on results
WECOA
WEATHER ENGINEERING
CORPORATION OF AMERICA

343 Washington Building,
Washington 5, D.C., U.S.A.
Cable: WECOAMOD Washington, D.C.
Tel: (202) 737-3814

tive personnel have expanded considerably.

Besides, certain far-reaching measures such as state partnership in cooperatives, state nomination to their Boards, massive state aid, etc. have also been introduced. These have a tremendous impact on the very character of the movement.

What are the trends perceived in the recent rapid development of the cooperative movement? A comprehensive treatise dealing with these questions on the basis of a critical review of the recent development in the Indian cooperative movement has not been published so far. This publication's title "Recent trends in the Cooperative Movement in India" suggests that it is such an attempt. But when one goes through it, one cannot but feel disappointed, for the book, as a grand exercise in precis-writing, mainly presents a summary of reports of committees and working groups in a chronological order. But it does not review or analyse or critically examine the trends in the recent development of various sectors of the movement separately and in the character of the movement as a whole, collating and presenting all relevant facts together.

In the first chapter, the author attempts to define cooperation and to state its principles briefly. The principles of cooperation have received excellent treatment in the hands of so many authorities like H. Calvert, G.D.H. Cole, Emory S. Bogardus, Arnold Bonner, etc., and the recent ICA Commission on Cooperative Principles (1966). The author could have listed the principles on the known lines. He has listed ten principles while the main principles as per the ICA Commission are only six in number. Even ideas that are inferred from principles such as — "Cooperation is a form of organization . . . a strictly business concern." "All for each, and each for all." "It possesses the peculiar faculty of making virtue pay . . ." have been listed as separate principles. But some of the main principles, viz., 'distribution of surplus in proportion to patronage,' 'cooperative education,' and 'cooperation among cooperatives' have not been included.

The later part of the book deals with certain stray themes such as cooperative commonwealth, cooperation in plan-

ed economy, International Cooperative Alliance, National Cooperative Union of India, International Labour Organization, etc.

To sum up, the book suffers from lack of conceptual clarity and scheme, logical sequence and analysis. It could, however, serve as a ready reference book for the summary of reports of committees and working groups on cooperation appointed during the period from 1945 to 1963.

O.R. Krishnaswami
Principal,
College of Rural Higher Education,
Coimbatore, India

The meaning of reforms

Land Reform in Principle and Practice, by Doreen Warriner. Clarendon Press, Oxford. 457 p. 63 sh.

The refreshing scepticism of this book will baffle those addicted to clichés. Abolition of feudalism? But there are hardly any feudal lords or vassals or *globae adscripti* to be found in those countries grappling with the problem of land reform. Satisfying land hunger? In some Iraqi villages, the governor is obliged to enlist police aid to compel many less-than-zealous farmers to cultivate all the land assigned to them, while in Venezuela, Miss Warriner could seldom track down the *parceleros,* some of them having disappeared, others preferring to live on agricultural credits. Employment security? In some parts of Italy, the *braccianti,* farming for themselves, find seven acres so exhausting to cultivate that they press uncles and brothers-in-law into service. On a short-term basis, it is difficult to evaluate the impact of a land reform on agricultural production or its direct bearing on economic growth; in the long run, however, judging by the author's references to Mexico, it appears that the benefits are reaped mainly by the latifundia, reduced in size but modernized. Elsewhere, no more than a healthy fear of reform has brought forth similar results. Taking the last passage in the book as Miss Warriner's conclusion, we can only pray heaven to send a well-primed guide for each separate region and village. "But how many such guides exist?" she asks sadly.

We should be ill-advised to take these words as the essence of her book. Although the author plays the devil's advocate to discourage all demands for ready-made models, she does offer a *pattern of approach* to the problems raised by land reform. Using well-chosen case histories, she helps the reader grasp the importance and complexity of the basic factors: natural and demographic conditions, the degree of economic growth, elements of social and political history, etc.

Early in her book, Miss Warriner proposes three of these 'model' structures: a) the Asian tenant-farming system; b) latifundism; and c) the plantation system. Although she insists on her pragmatic stand, it is a genuine theory, one of those which make it simpler to understand the task to be undertaken; and as a theorist, she cuts short the academic debate on the feudal or capitalistic nature of relationships in various underdeveloped third world areas by declaring that "what exists there is a mixture of defects of both (systems) without any of the qualities of either." She poses the question of the barrier which must be wiped out and rejects another false dilemma: should priority be given to economic development or to a recasting of the agrarian structure? The interdependence of these two aspects runs through the book — an excellent way to refuse to seek, in what constitutes an indispensable reform, a panacea against all the ills of the land and agriculture.

The fundamental problem

What about the constructive tasks of land reform? In all the cases examined, Miss Warriner tries, either directly or by implication, to find an answer to the key question: should a peasant agriculture be developed? If not, then what is the alternative? This is the fundamental problem faced by all nations which expect to maintain a high percentage of rural population in the decades to come. The author exposes its economic significance most clearly in her section on Yugoslav agricultural policies, but the observation is equally valid for Poland and other countries of various socialist tendencies. As she points out, the existence of an exceptionally fertile belt in northern Yugoslavia justifies, in a certain measure, the concentration of financial and technological resources on state farms, most of which are located in this area. But this brings up another question: will such a concentration eventually waste the country's greatest asset, its manpower? Would not a more generous allocation to the peasant sector prove more profitable and more likely widen its ties with the public sector? As for the underdeveloped countries treated by Miss Warriner, her replies to the question of a possible future for a peasant agriculture take the form of an informative spectrum. For Asia, on the whole, the answer is rather positive, including the seminomad groups 'not yet peasants' at one end and the great mass of Hindu peasants at the other, whose strict *zamindari* system paralyzed a series of reflexes in their production methods over the past century and a half. Such a process of atrophy has been even worse in various Latin American regions where the indigenous peasants were crushed by the *conquista;* and it has been total for the black masses uprooted from their native soil and thrown into slavery on the continent. Considering the semiserfdom of the peons, the vague status of the squatters and the sly vacillations practised by the personnel of modern plantations, all subsequent history up to our times has continued to debilitate the potential of human energy which, by exploiting the fabulous resources of the land, could convert it into one of the richest granaries in the world. In the light of these facts, one of Doreen Warriner's major conclusions is hardly surprising: land reform in the third world, in any region whatever and by whatever means must be costly to be effective.

This is the consequence of the disturbances provoked by an organic evolution which without the intrusion of the Europeans, would often have been ... more European.

In short, this is a book-seminar in several sessions, rich in material which permits the reader to participate in his own way. In our opinion, this is its prime virtue.

Jerzy Tepicht
University of Warsaw

Increase production and profit with a

CONTROLLED ENVIRONMENT
LIVESTOCK SYSTEM

The most efficient way to handle beef, dairy cattle or hogs.

Production can be greatly increased with additional savings on feed costs. You can provide healthier growing conditions for the animals and convert former pasture land to crops.

It's designed to save you time, money and to increase your profits.

Send for our literature. It will give you complete details on all the Clay Systems.

Distributors Note: Clay is looking for distributors in certain areas to sell the complete line of Clay Livestock Systems. If interested, contact us at once.

FREE CATALOGS - MAIL COUPON

CLAY EQUIPMENT CORP.
5028 Wilson Street, Cedar Falls, Iowa 50613 U. S. A.
Rush Catalogs on: ☐ Controlled Environment Hog Systems. ☐ Controlled Environment Beef Systems. ☐ Controlled Environment Dairy Systems. I am also interested in: ☐ Clay Liquid Manure Systems. ☐ Clay Silo Unloaders. ☐ Clay Grain Cleaners.

NAME _____ STUDENT_____

ADDRESS _____

CITY_____COUNTRY_____

BOOKS RECEIVED

Starvation or Plenty? by Colin Clark. Secker and Warburg, London, 1970, (171 p.), 30s.

International Targets for Development edited by Richard Symons. Faber and Faber, London, 1970, (261 p.), 50s.

Market Process in La Paz, Bolivia issued by the Latin American Studies Center, Michigan State University, 1970, (242 p.).

Market Process in the Recife Area of Northeast Brazil issued by the Latin American Studies Center, Michigan State University, (720 p.).

Half a Loaf, Canada's Semi-Role Among Developing Countries by Clyde Sanger. Ryerson Press, 1969, (267 p.), $3.95.

Agricultural Demonstration and Extension Communication by Ram Krishan. Asia Publishing House, 1970, (260 p.), 36s.

Sorghum by H. Dogget. Longmans, London, 1970, (403 p.), 130s.

Growth and Development of the Nigerian Economy by Carl Eicher and Carl Liedholm. Michigan State University Press, East Lansing, Michigan, 1970, (456 p.), $10.

Surplus Manpower in Agriculture and Economic Development by Prafulla Sanghvi. Asia Publishing House, 1970, (343 p.), 75s.

Famine in Retreat? by Gordon Bridger and Maurice de Soisson. J.M. Dent and Sons Ltd., London, 1970, (205 p.), 45s.

Thinking About Australian Aboriginal Welfare by Ronald M. Berndt. University of Western Australia, 1969, (41 p.), $A1.75.

The Australian Economy 1929-1969 by Herbert Burton. University of Western Australia, 1970, (27 p.), $A.75.

Some Methodological Achievements of the Hungarian Hybrid Maize Breeding by I. Kovàcs. Akadémiai Kiadò, Budapest, 1970, (385 p.), $12.

The World's Major Fibre Crops. Their Cultivation and Manuring by Joseph Berger. Centre d'etudes de l'azote, Zurich, 1969, (291 p.).

Economic Cooperation in Latin America, Africa and Asia by Miguel S. Wionczek. M.I.T. Press, London, 1970, (558 p.), 140s.

Experimental Research and Farm Production by B.R. Davidson and B.R. Martin. University of Western Australia Press, 1969, (68 p.), $A3.75.

The Agricultural Development of Venezuela by Louis E. Heaton. Praeger Publishers, New York, 1970, (350 p.), $15.

People and Planning by Norman Dennis. Faber and Faber, London, 1970, (391 p.), 90s.

A Day in the Life of the UN by James Munves. Washington Square Press, New York, 1970, (261 p.), $.95.

Aboriginal Progress: A New Era? by D.E. Hutchison. University of Western Australia Press, 1970, (189 p.), $A3.

Regional Development Banks, International Conciliation No. 576 by Manmohan Singh. Carnegie Endowment for International Peace, New York, 1970, (83 p.), $.60.

Regional Industrial Development in Central America by David E. Ramsett. Praeger Publishers, New York, 1969, (133 p.).

Urban Planning in the Developinng Countries by John D. Hebert and Alfred P. Van Huyck. Praeger Publishers, New York, 1969, (122 p.), $15.

Rural Development Planning by Earl M. Kulp. Praeger Publishers, New York, 1970, (688 p.), $18.

Communist China's Agriculture by Owen Dawson. Praeger Publishers, New York, 1970, (326 p.), $15.

For a biological agriculture

In his book *Le Monde est-il surpeuple?*, douard Bonnefous shows how western ndustry has created serious disorder by sub-ugating agriculture and how this offence gainst nature keeps warfare endemic and erpetuates pauperism in the developing ountries.

As an example, let us take the industry f chemical products destined for agriculture: nineral fertilizers, pesticides, insecticides, etc.

This powerful industry grew out of the work of a German chemist, Baron Justin von iebig, who sought to prove that "humus is o more a necessity imposed by nature than are dunghills."

However Liebig belatedly disclosed that his irst writings were based on ideas which experience proved to be entirely false. At the end of his life, he frankly recognized his error in his last testament:

"I duly confess that the use of mineral fertilizers was founded on suppositions which did not exist in fact... All mineral substances used up by the crops were to be replaced by mineral fertilizers... They were to make it possible to cultivate on any one field, continuously and without exhausting the soil, the same plant, clover, wheat, etc., according to the wishes and needs of the farmer..."

Why was this admission, which should have had wide repercussions, not heeded; especially since no biological justification for this agro-chemical method has ever been established?

There exists now ample documentation on the damages caused by this simplistic theory based on the 19th century's limited knowledge of biology. In his classic book *Geopolitics of hunger*, Josué de Castro already warned of its dangers:

"The United States, which uses artificial fertilizers on a scale unprecedented in the history of agriculture, has already exhausted one hundred million acres of land in a century... Yet Chinese agriculture, based on natural fertilizers, has thrived for 40 centuries without the soil showing the slightest sign of depletion..."

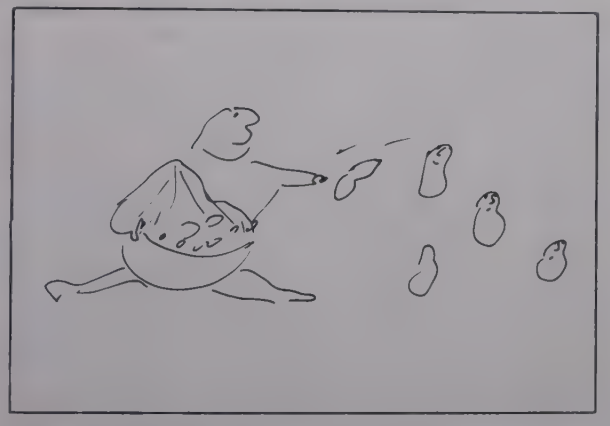
Fertilizer mentality

A new agronomic system, originated and ested in India at the beginning of this century nd recently propagated on a broader scale, cknowledges the life process and respects he laws of nature; hence its designation s 'biological agriculture.'

The great English agronomist Sir Albert Howard, agricultural adviser to the Central ndian States and Rajputana, devoted his life o questions concerning the development and naintenance of soil fertility. He denounced he 'fertilizer mentality' of western agriulture and the dangers of such a mentality, ooted in a superficial attitude toward the rofound realities of plant nutrition. Thus e proclaimed and urged the use of fertilizers btained from animal and plant residues, with a base added to neutralize the acidity, and called this agro-biological method the 'Indore process' after the Indian town.

In his memorable experiments, Sir Albert demonstrated that plants cultivated by his method were wholly immune to a number of diseases; moreover, that animals fed on these plants likewise developed a surprising resistance to various epizootic diseases common in the Far East.

We borrow an apt definition given by the French agriculturist E. Cussonneau in his *Petite grammaire de l'agriculture organobiologique*: "Biological derives from the word 'biology.' Biology is the science of the organic body. Thus, the soil is a living element, organized in its totality. It breathes, it must take nourishment to assimilate; it rejects such debris as animal and human excrement. It has age, a vocation, it can grow old and die."



An enormous population of microbes (bacteria, protozoa, algae and microscopic fungi), calculated at 5-6 000 kilos per hectare, helps maintain the life of the soil and improve it, as do rodents, insects, myriapoda and arachnida and particularly those precious, tireless earthworms (7-8 million per hectare in good soil), which predigest organic and mineral substances, thus providing more valuable nourishment for plants.

Brought to light by Professor Louis Kervan in 1962, the phenomenon of low-energy biological transmutations explains the how and why of biological-agricultural success.

The common denominator of all agro-biological methods consists of four distinct, inseparable stages:

— subsoiling, to loosen the soil without altering its structure;

— organic manure purified by the compost, which constitutes a real culture of micro-organisms;

— replacement of deep tilling by shallow tilling, to ventilate the soil without disturbing its microbial activities;

— cultivation of green fertilizers in plant associations to enrich the soil and restore its balance.

This method, by now well known, is being adopted more and more extensively in the U.K., Switzerland, the U.S., New Zealand, Morocco, the Ivory Coast and elsewhere, with agricultural associations striving to establish and propagate them..

Biological culture methods are not only encouraged by the Japanese Ministry of Agriculture but also taught in all agricultural faculties and specialized schools. In France, Professor Raoul Lemaire first gave his country a wheat variety stronger than the Canadian. After achieving the first two-crop grain variety, which can be sown both in the autumn and spring, and winning the world record for baking values with a W 675 wheat variety, Professor Lemaire then experimented successfully with organic fertilizers and the Delbet and Neveu magnesium treatments.

More recently, Professor Lemaire, aided by Jean Boucher, evolved a method which strongly advocates rotating grain crops in all its forms: "grain for man, straw for the earth." Exploiting Sykes' success in the U.K. and Pfeiffer's in Switzerland and the Federal Republic of Germany, combining plant association and the sanitizing of organic manures, this method calls for extensive utilization of a marine alga called lithothamne, found all along the Brittany coast. Crushed, powdered and mixed with natural phosphates or organic waste, lithothamne produces a purgative action on used or asphyxiated soil — or biocatalytic, equilibrating effects according to the season, dose and the purpose of its utilization.

This method, made available to French farmers, stock breeders and vine growers through excellent technical and commercial means, has had a significant success in France.

In 1969, its promoters counted about 15 000 cultivators who were using it on a total area of about 300 000 hectares.

To create an oasis

Again in France, Professor Jean Keiling, of the National Agronomic Institute and Director of the Institute of Biology, applied to nutrition and food, was the first to study the different aspects of microbian life in the soil and growth factors in plants. He has investigated every lead existing in research since about 1877, when the concept of 'soil biology' first appeared in scientific literature. He has intensified laboratory experiments, examined soil samples from every part of the globe and developed an indirect enzyme method to measure their biological activity (phosphatase).

In 1954, these efforts led to the production of a biological fertilizer, actually a bacterial leaven, that soon became known beyond the borders of France. Widely used in Spain, Italy and the Federal Republic of Germany, this bacterial fertilizer later made it possible to create the Hassi-Messaoud oasis deep in the Algerian Sahara, where flowers, lawn grass, fruits, vegetables and some 30 000 eucalyptus trees flourish on an area of about 30 hectares.

On the Canary Islands, in various countries of North and black Africa and most notably in the Near East — Libya, Lebanon, Syria, Saudi Arabia, Iran, Kuwait, Qatar and Abu Dhabi, where the sterile earth can be regenerat-

ed by restoring life to the soil — this bacterial leaven is being widely and efficiently tested. Tests are also under way in various parts of Asia — in India, Pakistan, the Philippines, Hong Kong and elsewhere.

Biological agriculture is based on respect for the vital forces and their exploitation, on the fecundity of the humus and the organic-biological equilibrium of the soil, to engender and maintain good fertility.

The most disinherited populations of the world will find in this system their greatest hope for survival and development.

Jacques Dangon
Angers, France

Water, source of life

The Bihar plain is sun-scorched, brown and dusty. Not a bush, not a blade of grass has survived the great drought of 1965. One must trudge miles to bring back a jar of water to the village. The villagers are condemned to forced idleness until the monsoon comes.

But near Gaya in this desolate expanse, three groups of emaciated peasants are working. Some are digging for water — not a water hole like so many which have long since become mere bowls of dry, cracked earth, but a real, cylindrical well, one metre in diameter and 15 metres deep. Others are building wooden casings into which cement will be poured, to make pipes. The third crew is making clay bricks to be dried in the sun and baked in the open air, eventually to face the walls of larger and deeper wells, four metres in diameter.

Working with them are four volunteers, with bronzed, glistening torsos, the eldest only 25. These are *Brothers to All Men*, who have come from France, the U.K. and Switzerland to help their fellow men. With the new techniques they have brought and the food they distribute every evening to the labourers they recruit and encourage, they have broken through the resignation and despair of the people they have come to help.

At the end of 1964, Armand Marquiset, founder of *The Little Brothers of the Poor* (Les petits frères des pauvres), was received by the Pope on his return from Bombay. The Holy Father concluded the audience with these words: "Be our successors in India."

Brothers to All Men thus came into existence as a nonsectarian organization of human solidarity, financed privately by gifts and small subscriptions. After a period of technical training in 1965, the first volunteers went into the field in India in 1966. Their activities are oriented toward education and development, with the stimulation of food aid to encourage study and work.

A small crew of youths organized a daily distribution of 25 000 meals in Calcutta's public schools, slightly more in New Delhi, with supplies furnished by American mutual aid organizations. Within the first few days, school attendance rose from 12 to 20%, and teachers reported not only a physical improvement in their pupils but, even more notably, a greater capacity to concentrate and absorb.

Impressed by these results, the city administration of Calcutta took over the public school food programme. *Brothers to All Men* are now pursuing their activities in the private schools of Calcutta and Howrah, distributing 10 million meals every year.

The first stage of the Bihar development programme ended in 1968 with 115 wells.

The second stage, now under way, is being directed by seven young volunteers. It calls for the construction of 50 large wells and an irrigation network equipped with India-made electric pumps. The power supply presents certain problems which, however, will be licked. Through their previous training, the volunteers can teach the peasants how to use selected seeds and fertilizers. Thus, in one corner of the world, employment is fostered, the plains are turning green, hunger and thirst are diminishing.

Learning from the example set by the volunteers and the hard work of the peasants during long, uninterrupted hours in the dust and mud at the bottom of the wells — their own wells dug to irrigate their own land — these are some of the features of *Water, Source of Life*, a 15-minute documentary filmed by *Brothers to All Men*, showing a successful microproject. "It is only a drop of water in the ocean," says M. Marquiset, "but oceans are made up of drops of water."

At Ouagadougou in Upper Volta, *Brothers to All Men* feed 5 500 schoolchildren every day. Again they note that, for the first time, better-fed children become better pupils. In Nogtédo, also in Upper Volta, the volunteers have flooded a depression to create a 1 300-acre expanse of water. Until recently, calabash fishing yielded about two pounds of fish a day; now, with more modern equipment, the fishermen, organized into a cooperative, catch about 1 300 pounds per pirogue every day. Similar projects are being set up in Brazil and Peru.

Challenging inevitability

I do not know whether M. Marquiset and his volunteers are aware of the *Young World Manifesto* proclaimed in Rome on 16 October 1965: "The earth is ruled mainly by people out of touch with the young world... It is more important to provide seed and water, schools and hospitals, so that we might feed and serve one another... Know your power and know what you must do... If you are educated in special knowledge and skills, see that your skills are used to help the needy... Above all, we must show our willingness to work for world development, and demand that we be given the opportunity..." *Brothers to All Men* have responded to this appeal with action. Challenging the inevitability of hunger and underdevelopment, these young men are practising Kant's precept: "Act only on that maxim through which you can at the same time will that it should become a universal law."

H.W.M.

The environment bomb

Environment suddenly is very big news indeed. Many countries are setting up special bodies to survey and prevent the deterioration of our environmental conditions.

Britain has established a Standing Royal Commission on Environmental Pollution; the OECD has a special working party; the Commission of the European Economic Community has been issuing stringent guidelines to its member countries but it is the United States, particularly, which has taken a clear lead in seeing the problem in 'crisis' terms.

It's almost a year ago that, in the U.S., President Nixon set up the Cabinet Committee on the Environment. This was a body composed of a few cabinet officers principally concerned with environment problems. It was chaired by the President himself and represented an attempt to come to grips — at the highest level — with the basic conflict between ecology and economy.

A danger to aid

Things moved fast. There was, last summer and fall, a sudden upsurge of interest across the land. At the end of the year, President Nixon signed into law the National Environmental Policy Act of 1969. The purposes of the Act were: to declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere of man; to enrich the understanding of the ecological systems and natural resources important to the nation; to establish a Council on Environmental Quality.

The function of this last body, which is still in the process of formation, is — inter alia — to prepare an annual Environmetal Quality Report: to collect and analyse information and to prepare long-term studies; to review and appraise the various programmes and activities of the United States Government in the light of the new environmental concern.

To all this one can only say 'hurrah!' Anyone who has lived in America can only shout with joy that — or so it seems — at last something is to be done about this land of nonreturnable bottles and junked automobiles, this desert of use-car lots set in a concrete sea, this non-Eden. Yet relief must be tempered with caution. For this strange and heady concern with the 'quality of life' may — unless we are careful — have some very untoward consequences.

Foreign aid will be the first to suffer. It always is. There is, in American public life, some immutable law that requires it, a Pavlovian reaction which has over the years seen a steady reduction in the size of foreign aid commitment.

Slash foreign aid. Always an unpopular programme, foreign aid in the United States is now exposed to the most profound and most insidious threat of its short and chequered life. For the danger, the very real danger, is that the environment will provide

e perfect excuse for a complete American opout on the aid scene and a final retreat to insularity. Even before that point is ached there will be some environmental 'spill-vers' which will have a very significant im-ct on the quality and effectiveness of such d as may be given, and on the whole pro-ss of development itself. DDT is a case in oint. Clearly no one should ignore, or lightly smiss, the environmental consequences of ntinued and widespread use of these particu-r organochlorines.

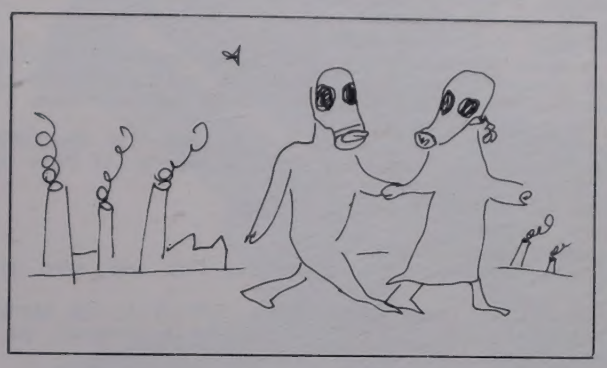
Yet, a note of caution should be injected. he World Health Organization has pointed ut that the peculiar properties of DDT make a unique tool in the armamentarium of ealth workers, not the least of which is its elative cheapness as well as its effectiveness. And the Food and Agriculture Organiza-on, similarly, will point out that DDT has ver the years proved a cheap and effective gent of pest control. Clearly there have een problems of misuse and overuse, but all he same, hungry mouths have been fed, and ed *economically* — which is the whole point. The United States and other advanced na-ions can no doubt afford to ban DDT. There re alternative compounds available to them. But these compounds are not necessarily avail-ble, on economic terms, to the developing countries. And, technically the job may be different one. This should not be taken as n argument *for* DDT. I mention it merely s an example of the complexity of the envi-onment problem, particularly when different eeds, different uses and different degrees of vealth need to be taken into account.

But the environment bomb is much bigger han this. Those who work in the 'field of levelopment,' as the jargon has it, should e aware that they are threatened with an xplosion which may shake, if not destroy, he very basis and foundation of their work.

There is a school of thought today in Amer-ca which can demonstrate with some plausi-ility that if economic 'bads' could be uantified and measured against economic goods,' it could be shown that the U.S. conomy has failed to grow in any meaning-ul sense since 1750. The whole concept of xpansion for its own sake is under attack.

Ecological humility seems to have replaced ld myths and religions. All this is of pro-ound significance to the cause of economic evelopment. It is but a short step — for mericans — from questioning growth at ome to questioning growth abroad. The ire warnings, for example, scientists have iven about the rise in the level of carbon ioxide in the atmosphere may sooner or ter cause a radical revision in U.S. aid olicies. Aid administrators, in the face of ublic pressure, may have to question their asic assumption that the purpose of aid is, ter alia, to foster the specialization of la-our and the process of industrialization. For dustrialization means factories and cars; it eans a steady rise in the global consump-on of fossil fuels; it means increasing af-uence and the consumption patterns which with affluence. If problems like carbon oxide are already acute when a mere frac-tion of the world is living at North American standards, how much worse will they get when another two or three thousand million people begin to spew out the effluents of wealth. And even if the West has by then learned how to develop antipollution mechanisms, there is no guarantee that the less developed countries will be able to adopt and maintain the necessary technology.

Or again, notwithstanding the success of the Green Revolution, aid administrators — faced with the contamination of the marine ecology through agricultural runoff — may have to rethink agricultural strategies which rely on the intensive use of fertilizers and pesticides. The world (so the environmentalists may argue) cannot afford the marginal increment of pollution involved.



So far from being the engines (or at least the spark plugs) of economic development throughout the world, major donor countries may insist on the World Bank and the UNDP becoming global ecological policemen. The 'haves' would, in effect, be saying to the 'have-nots,' " Look, fellahs, we know we loused it all up. We're sorry there's going to be too much carbon dioxide if you add your industrialization-urbanization-consumption to what we've already got. But that's the way the cookie crumbles. When it comes to the crunch, the skin we save is our own. "

Suspicions

Those who have been involved in the preparatory work for the 1972 United Nations Conference on the Environment can already sense that the developing countries regard the whole exercise with profound suspicion. They see it as an excuse to perpetuate the schism between rich and poor, light and dark. They listen to fine flurries of rhetoric about the aesthetic value of zebras and wildebeeste and Thompson's gazelle and they are, frankly, amazed. They know poverty and squalor and starvation and they are damned if a few middle-aged overfed white tourists masquerading as ecologists are going to tell them how to run a country.

How is the environment bomb to be defused? As far as public opinion is concerned, the environment problem could be used as a catalyst for more, not less, foreign aid. The lesson of ecology is that there are points of interaction, bonds of interdependence between man and nature at the level of each different biome, from grasslands or tropical rain forest to the man-made urban environment. The environment is not just our environment; it is everybody's.

But this means that there may indeed need to be some changes in the nature of the aid relationship. Clearly donor agencies should encourage recipients to take into account all possible environmental and ecological consequences of the projects they propose. At the very least, it is bad planning not to do so.

The benefits from tourism that accrue to Uganda from the existence of the Murchison Falls, for example, may far outweigh the benefits from using the falls for hydroelectric power. And careless use of pesticides can become uneconomic and counterproductive as resistant strains of insects are produced and natural predators haphazardly destroyed.

An educational effort, however comprehensive, can only take us part of the way. When all the *caveats* have been made, there will still be a conflict between the desires of the less developed countries for development (merely to keep abreast of population growth, to say nothing of an increase in per capita living standards) and the tolerance of the ecosystem. If these countries are to develop economically, the industrial nations — and we can include in this the Soviet Union and other countries of Eastern Europe — may have to impose a kind of quota system on themselves.

When they get together in Prague next year, at the Conference on the Environment of the UN Economic Commission for Europe, the industrial nations should seek to reach agreements limiting the global pollution of air and water which is caused primarily by their own economies. Those who produce so much of the world's wealth while comprising so little of its population have already used up far more than their fair share of the scarce resources of the biosphere. The 'first come, first served' basis on which exploitation of these international 'goods' has so far been conducted is entirely inappropriate now that the new ecological era has dawned. The industrial nations of the Economic Commission for Europe (the United States is a member but we should also include Japan) will need to restrain their own rate of growth, modify their consumption patterns and devote more of their resources to maintenance and less, far less, to achieving increases in production and consumption.

If the West and the developed East could take this approach at Prague next year, if they could raise among themselves these fundamental questions, there is a chance that the 1972 World Conference on the Environment might be something more than a fiasco. Some good might come from this Nazareth.

Stanley Johnson
Minehead, Somerset, U.K.

CREDITS

Cover photo from *NASA*; drawings pages 22-23, 24-25, 63, 65 *Paula*; graphics pages 9, 17, 36-37, 41 *CERES*; photographs page 27 *UN*; 29 *J.D. Pearson* for *FAO*; 31 *Patrick Morin (FAO)*; 32-33, 52-53 *Florita Botts (FAO)*; 34, 38 *T.M. Pasca (FAO)*; 42, 43, 45, 46 *Robert Colwell* and *NASA*; 48-49 *Communications Media Centre/FAO*; 50 *Almasy*; 54 *Thane Riney (FAO)*.

ceres

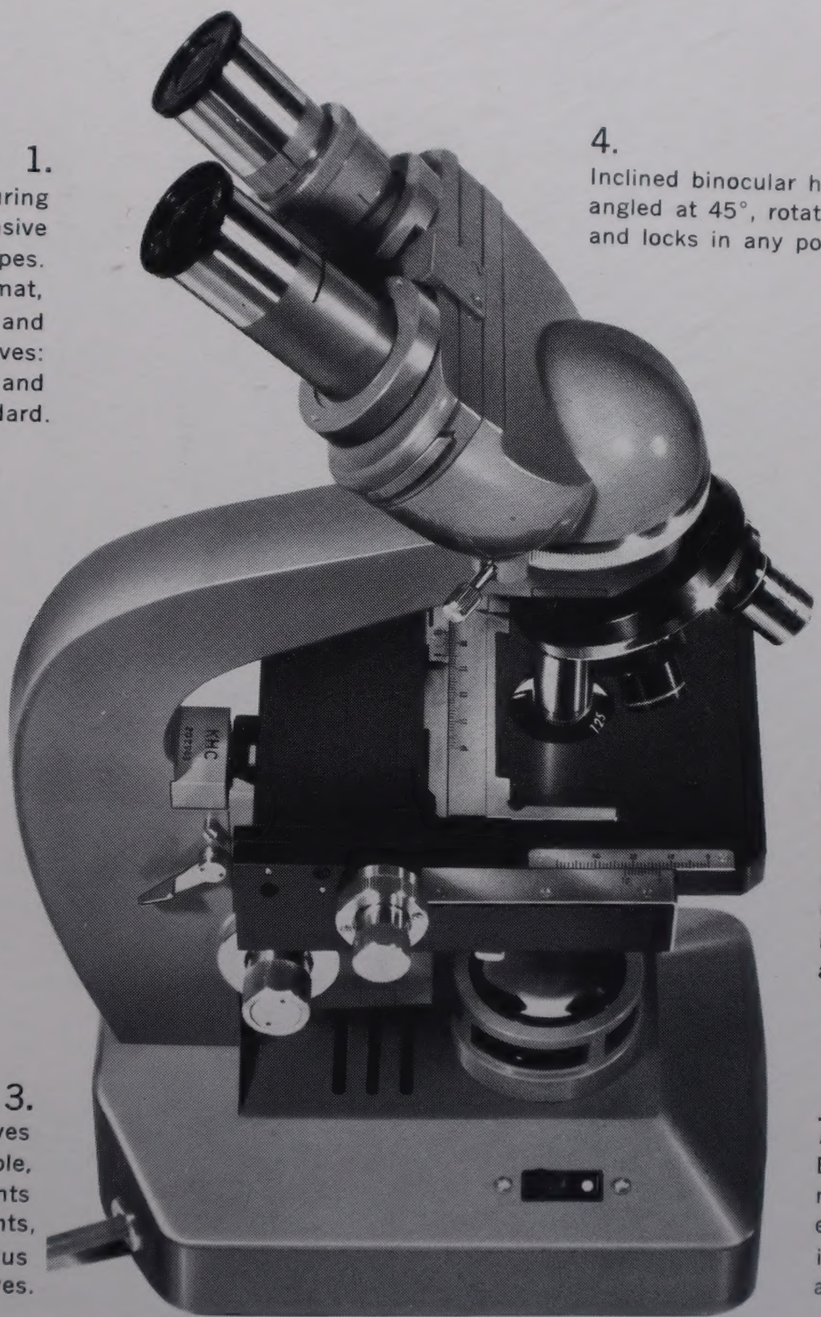
and other FAO publications are on sale throughout the world

Argentina	Editorial Sudamericana, S.A., Humberto I 545, Buenos Aires.
Australia	Hunter Publications, 23 McKillop Street, Melbourne C.1; Publications Branch, Government Printing Office, Canberra, A.C.T. 2600, and outlets in each state capital city.
Austria	Wilhelm Frick Buchhandlung, Graben 27, Vienna 1.
Belgium	Agence et Messageries de la Presse, 1 rue de la Petite Ile, Brussels, 7.
Bolivia	Librería y Editorial "Juventud," Plaza Murillo 519, La Paz; Librería Alfonso Tejerina, Comercio 1073, La Paz.
Brazil	Livraria Mestre Jou, Rua Martins Fontes 99, São Paulo; Trav. do Ouvidor 14-A, Río de Janeiro.
Bulgaria	Hèmus, 11 place Slaveïkov, Sofia.
Cameroon	"Le monde noir," B.P. 736, Yaoundé.
Canada	Queen's Printer, Ottawa.
Ceylon	M.D. Gunasena and Co. Ltd., 217 Norris Road, Colombo 11.
Chile	Biblioteca, FAO Oficina Regional para América Latina, Av. Providencia 871, Casilla 10095, Santiago; Librerías Renacimiento, Amunategui 458, Santiago; Editorial y Distribuidora Orbe Ltda., Galería Imperio 256, Santiago; Sergio Feliú Cía. Ltda., "Chile Libros," Av. Santa María 281, Santiago.
Colombia	"Agricultura Tropical," Avenida Jiménez Nº 7-25, Ofcs. 811/816, Bogotá; Librería Central, Calle 14, Nº 6-88, Bogotá
Costa Rica	Imprenta y Librería Trejos, S.A., Apartado 1313, San José.
Cuba	Instituto del Libro, Calle 19 y 10 Nº 1002, Vedado.
Cyprus	MAM, P.O. Box 1722, Nicosia.
Denmark	Ejnar Munksgaard, Norregade 6, Copenhagen S.
Ecuador	Librería Universitaria, García Moreno 739, Quito; Su Librería, Plaza de Independencia, Quito.
El Salvador	Librería Cultural Salvadoreña S.A., 6ª Calle Oriente 118, Edificio San Martín, San Salvador.
Ethiopia	International Press Agency, P.O. Box No. 120, Addis Ababa.
Finland	Akateeminen Kirjakauppa, 2 Keskuskatu, Helsinki.
France	Editions A. Pedone, 13 rue Soufflot, Paris 5e.
Germany	Paul Parey, Lindenstrasse 44-47, Berlin SW 61.
Greece	"Eleftheroudakis," 4 Nikis Street, Athens; Institute of Scientific Publications, 9 Amerikis Street, Athens.
Guatemala	Sociedad Económico Financiera, Edificio "El Cielito," Despacho 222, Zona 1, Guatemala.
Haiti	Max Bouchereau, Librairie "A la Caravelle," B.P. 111B, Port-au-Prince.
Hong Kong	Swindon Book Co., 13-15 Lock Road, Kowloon.
Iceland	Snaebjörn Jónsson and Co. h.f., Hafnarstraeti 9, P.O. Box 1131, Reykjavik.
India	Oxford Book and Stationery Co., Scindia House, New Delhi; 17 Park Street, Calcutta.
Indonesia	Pembangunan Ltd., 84 Gunung Sahari, Jakarta.
Iran	Economist Tehran, 99 Sevom Esfand Avenue, Tehran.
Iraq	Mackenzie's Bookshop, Baghdad.
Ireland	The Controller, Stationery Office, Dublin.
Israel	Emanuel Brown, formerly Blumstein's Bookstores Ltd, P.O. Box 4101, 35 Allenby Road, and Nachlat Benyamin Street, Tel Aviv.
Italy	Libreria Internazionale Rizzoli, Largo Chigi, Rome; A.E.I.O.U., Via Meravigli 16, Milan: Libreria Commissionaria Sansoni, S.p.A., Via Lamarmora 45, Florence; Libreria Macchiaroli, Via Carducci 55/59, 80121 Naples.
Jamaica	Bolivar, 1 Grove Road, Kingston 10.
Japan	Maruzen Company Ltd., P.O. Box 5050, Tokyo International 100.
Kenya	The E.S.A. Bookshop, P.O. Box 30167, Nairobi; University Bookshop, University College, P.O. Box 30197, Nairobi.
Korea	The Eul-Yoo Publishing Co. Ltd., 5 2-Ka, Chong-ro, Seoul.
Lebanon	Dar Al-Maaref Liban S.A.L., place Riad El-Solh, B.P. 2320, Beirut.
Malaysia	Caxton Stationers Ltd., 13-15 Leboh Pasar Besar, Kuala Lumpur.
Mauritius	Nalanda Company Limited, 30 Bourbon Street, Port Louis.
Mexico	Manuel Gómez Pezuela e Hijo, Donceles 12, Mexico, D.F.; Editorial Iztaccihuatl, S.A., Miguel Schultz 21, México 4, D.F.; Av. Morelos Ote 437, Monterrey N.L.; Colón 175, Guadalajara, Jal.
Morocco	Librairie "Aux Belles Images," 281 avenue Mohammed V, Rabat.
Netherlands	N.V. Martinus Nijhoff, Lange Voorhout 9, The Hague.
New Zealand	Government Printing Office: Government Bookshops at Rutland Street, P.O. Box 5344, Auckland; Mulgrave St., Private Bag, Wellington; 130 Oxford Terrace, P.O. Box 1721, Christchurch; Princes Street, P.O. Box 1104, Dunedin; Alma Street, P.O. Box 857, Hamilton.
Nicaragua	Librería Universal, 15 de Septiembre 301, Managua.
Nigeria	University Bookshop Nigeria Ltd., University College, Ibadan.
Norway	Johan Grundt Tanum Forlag, Karl Johansgt. 43, Oslo.
Pakistan, East	Shilpa Niketan 29 D.I.T. Super Market, Mymensingh Road, Dacca-2.
Pakistan, West	Mirza Book Agency, 65 The Mall, Lahore 3.
Panama	Agencia Internacional de Publicaciones J. Menéndez, Apartado 2052, Panama.
Paraguay	Agencia de Librerías de Salvador Nizza, Calle Pte. Franco Nº 39-43, Asunción.
Peru	Librería Internacional del Perú, S.A., Casilla 1417, Lima; Librería La Universidad, Av. Nicolás de Piérola 639, Lima; Librería Studium, Amargura 939, Lima; Distribuidora Inca, Emilio Althaus 470, Lince, Lima.
Philippines	The Modern Book Company, 928 Rizal Avenue, Manila.
Poland	Ars Polona, Krakowskie Przedmiescie 7, Warsaw; Ruch Export-Import Enterprise, Ul. Wronia 23, Warsaw.
Portugal	Livraria Bertrand, S.A.R.L., Apartado 37, Amadora.
Romania	Cartimex, P.O. Box 134-135, Bucharest.
Saudi Arabia	Khazindar Establishment, King Faysal Street, Riyadh.
South Africa	Van Schaik's Book Store Ltd., P.O. Box 724, Pretoria.
Spain	Librería Mundi-Prensa, Castelló 37, Madrid; Librería Agricola, Fernando VI 2, Madrid 4; José Bosch, Librero, Ronda Universidad 11, Barcelona; Adlha, Av. Gen. Mitre 100, Barcelona; Librería General, S. Miguel 4, Saragossa.
Sweden	C.E. Fritze, Fredsgatan 2, Stockholm 16; Gumperts A.B., Göteborg; Universitetsbokhandel, Sveavägen 166, Stockholm Va.
Switzerland	Librairie Payot S.A., Lausanne and Geneva; Hans Raunhardt, Kirchgasse 17, Zurich 1.
Syria	Librairie Internationale, B.P. 2456, Damascus.
Taiwan	The World Book Company Ltd., 99 Chungking South Road, Section 1, Taipeh.
Tanzania	Dar es Salaam Bookshop, P.O. Box 9030, Dar es Salaam.
Thailand	FAO Regional Office for Asia and the Far East, Maliwan Mansion, Bangkok; Suksapan Panit, Mansion 9, Rajadamnern Avenue, Bangkok.
Togo	Librairie du Bon Pasteur, B.P. 1164, Lomé.
Turkey	Librairie Hachette, 469 Istiklal Caddesi, Beyoglu, Instanbul.
Uganda	The E.S.A. Bookshop, P.O. Box 2615, Kampala.
United Arab Republic	Librairie Hachette, 45 bis rue Champollion, Cairo.
United Kingdom	Her Majesty's Stationery Office, 49 High Holborn, London, W.C.1; P.O. Box 569, London, S.E.1 (Trade and London area mail orders); 13a Castle Street, Edinburgh EH2 3AR; 109 St. Mary Street, Cardiff CF1 1JW; Linenhall Street, Belfast BT2 8AY; Brazennose Street, Manchester M60 8AS; 259 Broad Street, Birmingham 1; 50 Fairfax Street, Bristol BS1 3DE.
United States of America	UNIPUB, Inc., 650 First Avenue, P.O. Box 433, New York, N.Y. 10016.
Uruguay	Editorial Losada Uruguaya S.A., Maldonado 1092, Montevideo; Barreiro y Ramos, 25 de Mayo esq. J.C. Gómez, Montevideo; Librería Albe, Soc. Com., Cerrito 566, Montevideo.
Venezuela	Suma S.A., Calle Real de Sabana Grande, Caracas; Librería Politécnica, Apartado del Este 4845, Caracas; Librería del Este, Pericás S.A., Av. Fco. de Miranda 52, Edificio Galipán, Caracas; Librería Técnica Vega, Plaza Las Tres Gracias, Edificio Odeón, Los Chaguaramos, Caracas.
Yugoslavia	Jugoslovenska Knjiga, Terazije 27/11, Belgrade; Prosveta Export-Import Agency, Terazije 16, Belgrade; Cankarjeva Zalozba, P.O. Box 201 - IV, Ljubljana.
Other countries	Requests from countries where sales agents have not yet been appointed may be sent to: Distribution and Sales Section, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, Rome 00100, Italy.

FAO publications are priced in U.S. dollars, pounds sterling and French francs. Payment to FAO sales agents may be made in local currencies.

Printed in Italy by TILLIGRAF - ROME PP/A1589/6.70/E/1/22000

Olympus KHC is top choice for latest features and low budget



1.
Wide field or measuring eyepieces as in expensive research microscopes. Highest quality Achromat, Plan Achromat and Fluorite objectives: Achromat 4×, 10×, 40× and 100× (oil) standard.

2.
Fine and course focusing knobs are coaxial and positioned low for ease of operation.

3.
Modern design improves handling ease. For example, vertical stage focusing prevents distracting head movements, and pre-set focus lock protects slides and objectives.

4.
Inclined binocular head, angled at 45°, rotates through 360° and locks in any position.

5.
Square mechanical stage is coaxially-controlled and vernier calibrated to give exact positioning of slides.

6.
Abbe type condenser, N.A. 125, is focusable with rack and pinion. Continuously variable iris diaphragm allows adjustment of illumination.

7.
Built-in 20-watt illuminator needs no centering, eliminates accessory illuminators and transformers.

Olympus KHC is the latest improvement for everyday laboratory work, a microscope for the lowest budget and still featuring eye-fatigue-free clearness and high precision. Its seven outstanding features have made KHC the most used and valued instrument for medical students and laboratory workers all over the world.
Total magnification: 40x~1000x

Camera, Microscope, Optical measuring instrument, Medical instrument

OLYMPUS TOKYO **OLYMPUS**

OLYMPUS OPTICAL CO., LTD. 43-2 Hatagaya 2-chome, Shibuya-ku, Tokyo, Japan

Dieldrin
v
The Desert Locust

Check-mate before the first move

Dieldrin is widely recognized as the best insecticide for preventing desert locusts ever leaving their breeding ground.

Small amounts of dieldrin solution safeguard vast food supplies. One litre sprayed over 2 hectares can control 40,000 hopper locusts. These would consume as much food in one day as 20 people, if allowed to reach the swarm stage.

Shell companies are situated in key areas to ensure that supplies are immediately available where they are needed.

Locust control is just one of dieldrin's many uses. It is being used all over the world to protect many different crops against a wide range of pests. It is also much used in industry and public health schemes. Dieldrin is available in a range of formulations, and when used as directed is harmless to both applicators and consumers of crops.

For full details of approved uses and advice on application, please consult your Shell company or Shell Chemicals distributor.

Shell Chemicals SHELL